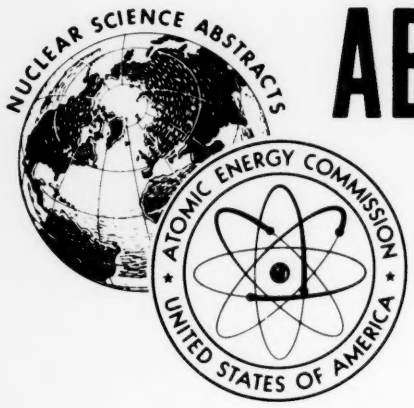
NUCLEAR SCIENCE ABSTRACTS



Volume 27 Number 8

Abstracts 16951-19421

April 30, 1973

UNITED STATES ATOMIC ENERGY COMMISSION

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Volume 27, Number 8, April 30, 1973

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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NEWKIRK, L. R., Superconductivity in the pseudobinary alloys V_3Si--Nb_3Al, 25:1093 (CALT-822-13)
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TRANSURANIUM ELEMENTS
determination in bone ash, radiochemical method for, 25:40 (IDO-12073, pp 28-36)
separation by ion exchange and complex-formation elution, 25:251(P)
TRIETHYLENETETRAMINE
complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
determination in luminescent material by scintillation counting, 25:40 (IDO-12073, pp 28-36)

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372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

is indexed as:

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Construction of a unique underground whole body counter, 25:372 (UCRL-72739)

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Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 27, Number 8 April 30, 1973

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

16951 (AECL-4351) CHEMISTRY AND MATERIALS DIVISION PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Oct 1972. 106p. (PR-CMa-22). Dep. NTIS (U. S. Sales Only). AECL $2.00.

Research is reported for studies in Solid State Science Branch, General Chemistry Branch, Physical Chemistry Branch (including radiation and isotope chemistry), and Materials Branch. Publications resulting from the work are listed. (DHM)

Analytical Chemistry

Refer also to abstracts 17453, 17883, and 19030.

16952 (ORNL-4838) ANALYTICAL CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1972. Lyon, W. S. (comp.) (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 94p. Dep. NTIS.

A report of the activities of ORNL Analytical Chemistry Division for the period ending September 30, 1972 is presented that includes instrumentation and advanced methodology, bio-organic analysis, energy programs, nuclear and radiochemistry, spectrometry and physics methods, methods development and special projects, service analyses, and environmental activities. (DHM)

16953 NUCLEAR METHODS OF CHEMICAL ANALYSIS. Menon, M. P. (Savannah State Coll., GA); Wainerdi, R. E. pp 116-145 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

Topics considered in a review of nuclear methods of chemical analysis are: measurement of radioactivity, analysis by natural radioactivity, radiometric methods of analysis, isotope dilution, analysis by radiation scattering and absorption, and activation analysis. (DHM)

16954 ANALYTICAL TECHNIQUES FOR THE NOBLE METALS. Beamish, F. E.; Van Loon, J. C. (Univ. of Toronto). pp 307-334 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

A review on the analytical chemistry of the six platinum metals and gold is presented that includes dissolution and/or concentration by fire assay, chlorination, and wet treatment using fusion and acid leaching; separation by distillation, solvent extraction, precipitation, and chromatography; and determination by gravimetry, spectrophotometry, titrimetry, emission spectrography, x-ray fluorescence spectroscopy, atomic absorption spectrophotometry, neutron activation analysis, and electroanalytical methods. (DHM)

16955 SOME RECENT DEVELOPMENTS IN INORGANIC ULTRAMICROANALYSIS. Graham, C. L.; Wilson, C. L. (Queen's Univ., Belfast). pp 394-408 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

A history of ultramicroanalysis is presented including a comparison of titrimetric, neutron activation, and gravimetric methods for determining nanogram quantities of antimony. (DHM)

Activation and Nuclear Reaction Procedures

Refer also to abstract 17287.

16956 (CEA-CONF-2123) EXACT LOCALIZATION OF FLUORINE ALONG POLLUTED ABIES ALBA USING MICRO-ANALYSIS WITH PROTONS. Garrec, J.-P.; Ligeon, E.; Bontemps, A.; Bligny, R.; Fourcy, A. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1972. 9p. (In French). (CONF 721069-6). Dep. NTIS (U. S. Sales Only).

Nuclear reaction microanalysis was used to study the distribution of polluting elements in plants. It is in this way that the distribution of the fluorine accumulated in the polluted needles of Abies alba was determined, the α particles produced in the $^{19}F(p,\alpha)^{16}O$ reaction being detected directly. This technique, which enables the fluorine concentration at the surface to be determined, led to the establishment of two distinct sites in which the fluorine accumulates at the necrosis point of the needle, and in the narrow demarcation band between the healthy and necrosis tissue. The distribution of the fluorine along the needle and the contents measured differ for the two faces; the upper face being more polluted than the lower face. The age of the needles also affects the fluorine accumulation. (France)

16957 (CONF-721010-30) DEPTH DISTRIBUTION OF LIGHT ELEMENTS IN HEAVY MATRICES WITH CHARGED PARTICLE INDUCED REACTIONS. Lorenzen, J.; Brune, D.; Malmskog, S. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1972. 13p. Dep. NTIS (U. S. Sales Only).

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

Two different methods are described to measure the depth distribution of carbon, nitrogen, and oxygen in metals. Proton activation makes use of resonances in the excitation function of the (p,γ) reactions for depth determination and with the aid of the different half-lives for β^+ decay provides information about the different constituents present. The other method makes use of the shape of neutron groups in the time-of-flight spectra from deuteron-induced reactions. Depths of some tens of microns with a resolution of fractions of a micron are studied. The detection limit is of the order of 100 ppM. (auth)

16958 (CONF-721069-2) PROBLEMS IN THE ELEMENTARY ANALYSIS OF STANDARD BIOLOGICAL MATERIALS. Bowen, H. J. M. (Reading Univ. (England). Dept. of Chemistry). 1972. 10p. Dep. NTIS (U. S. Sales Only).

Neutron activation analysis was used to obtain reasonably consistent values for the following 35 elements in standard kale: Al, As, Au, B, Ba, Br, Ca, Cd, Cl, Co, Cr, Cs, Cu, F, Fe, Hg, K, La, Mg, Mn, Mo, N, Na, P, Pb, Rb, S, Sb, Sc, Si, Sn, U, V, W and Zn; inconsistencies remain for Ag, Ce, Ga, I, Ir, Ni, Se, Sm and Ti. For blood, analyses of the following 17 elements were sufficiently consistent to allow the use of the material as a rough standard: Ba, Br, Ca, Cl, Cu, Fe, I, K, Mg, Na, Ni, P, Pb, Rb, Se and Zn. There are serious doubts about the constancy of some of these in individuals, and also about the constancy of Ag, As, Co, Cr, F, Hg and Sb. Results are tabulated for analyses of kale, blood, red cells, and blood serum. (auth)

16959 (CONF-721069-3) NEUTRON ACTIVATION ANALYSIS OF SOILS. Buenafama, H. D. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 10p. Dep. NTIS (U. S. Sales Only).

Neutron activation analysis of soils using high-resolution Ge(Li) detectors for determination of 31 elements is described. The elements determined include alkali metals, alkaline earths, rare

earths, and transition elements, most of them being useful as indices for geochemical differentiation, and some of them being useful as nutrients in plant physiology. Some elements, including Na, K, Rb, Cs, Ba, La, Ce, Sm, Eu, Th, Zr, Hf, Ta, Mn, Co, Fe, Sc, Cr, Sb, Ca, V, Al, Ti, Br, and U were determined by nondestructive gamma spectrometry, and others, Mo, W, Sr, Cu, Zn, and Ga after a simple radiochemical separation based on ion exchange and solvent extraction. Epithermal activation with reactor neutrons was used for U determination. Interference reactions, photopeaks, self-shielding, and other possible sources of error are analyzed and evaluated wherever possible. (France)

16960 (EURISOTOP-68) DETERMINATION OF OXYGEN IN NONFERROUS METALS BY 14 MeV NEUTRON ACTIVATION ANALYSIS. Vandecasteele, C.; Speecke, A.; Hoste, J. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Dec 1972. 55p. Dep. NTIS (U. S. Sales Only).

The determination of oxygen in 9 nonferrous metals, Al, Ti, Cu, Zr, Nb, Mo, Ta, W, Pb, was studied in detail. Optimal irradiation and counting conditions are proposed. A general standardization method for the determination of oxygen in nonferrous metals is described, using a primary oxygen standard consisting of a cylindrical steel box filled with a compressed Fe_2O_3–graphite pellet. The flux is monitored with an oxygen standard or by means of a BF_3 long counter. Geometry effects at the irradiation and counting site, screening of the flux monitor by the sample, fast neutron scattering, absorption of fast neutrons and of ^{16}N gamma-rays in sample and standard are considered, and appropriate correction factors are established. For each of the studied metals, possible interferences are investigated. Considerable attention is paid to surface contamination before and during the irradiation. Appropriate surface treatments are considered. A chemical etch after the irradiation is preferred. The 14 MeV NAA is compared with chemical methods and charged particle activation analysis for the determination of oxygen. (auth)

16961 (FRNC-CONF-68) ACCURATE NONDESTRUCTIVE ANALYSIS OF SMALL QUANTITIES OF ELEMENTS PRESENT IN SOLIDS USING ACTIVATION ANALYSIS WITH PILE NEUTRONS. Bussiere, P.; Laurent, A. (Institut C.N.R.S. de Recherche sur la Catalyse, Villeurbanne (France)). 1972 6p. (In French). (CONF-721069-4). Dep. NTIS (U. S. Sales Only).

From International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Routine nondestructive determinations can be effected with an accuracy of within a few percent by the radioactivation of small solid samples. Such analyses often require a relatively short duration single irradiation (a few minutes up to an hour) with nominal fluxes ranging from 10^{12} to 10^{13} n cm^{-2} s^{-1}. The possible sources of error (calibration, irradiation, and activity measurements) are discussed in the following cases: determination of Na in silica–alumina; Cl in silica, alumina, silica–alumina and TiO_2; Br in organic polymers containing Cl and Cu; Sb, Ga, Mo, Ta, in TiO_2; and Sc in textile fibers containing an activable tracer. (France)

16962 (FRNC-CONF-75) UTILIZATION OF A SEMICONDUCTOR DETECTOR IN THE SYSTEMATIC ANALYSIS OF Al. Blouri, J.; Fedoroff, M.; Revel, G. (Centre National de la Recherche Scientifique, Vitry (France)). 1972. 11p. (In French). (CONF-721069-1). Dep. NTIS (U. S. Sales Only).

From International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

After irradiating Al samples (of various origins) with a 3×10^{12} n cm^{-2} s^{-1} neutron flux, some 30 elements can be determined without chemical separation. A description is given of the way in which the measurements are made and the radioactivity calculations performed. The detection limits are indicated. They lie between 5×10^{-2} and 5×10^{-6} ng/g depending upon the element sought. For certain of these elements (Fe, Zn, and Zr) these limits can be improved by a simple chemical separation. (France)

16963 (ORO-3922-6) DETERMINATION OF SULFUR BY CHARGED PARTICLE ACTIVATION ANALYSIS. Dabney, S.A.; Swindle, D.L.; Beck, J.N.; Francis, G.; Schweikert, E.A. (Texas Agricultural and Mechanical Univ., College Station). 1972. Contract AT(40-1)-3922. 8p. (CONF-721010-20). Dep. NTIS.

An analytical method is described for the determination of trace amounts of sulfur by charged particle activation analysis. The method consists of proton irradiation followed by a rapid radiochemical separation of the product nuclide, ^{34m}Cl. This procedure was applied to a number of pure metal samples which range in sulfur content from 0.3 to 30 ppM. All analyses were repeated several times to ensure consistent results and to better evaluate experimental detection limits and systematic errors. The results indicate that sulfur determinations can be performed at a concentration of less than 1.0 ppM. Activation curves are presented for the reactions $S(d, x)^{34m}Cl$, $S(p, x)^{34m}Cl$, and the interfering reaction $^{35}Cl(p, pn)^{34m}Cl$. (auth)

16964 MAJOR ELEMENT ANALYSIS WITH ACCELERATOR BEAM INDUCED γ RAYS. Shabason, L.; Cohen, B. L. (Univ. of Pittsburgh). Anal. Chem.; 45: No. 2, 284-287(Feb 1973).

A method is described for obtaining a quantitative analysis of the major elements ($\gtrsim$1%) in a specimen by measuring γ rays induced by bombardment of a "thick" sample with a proton beam. The method is less accurate than conventional chemical analysis, but is very simple and cheap, and can be done with much smaller sample sizes. The method is especially accurate for determinations of the ratio of two elements in a sample. (auth)

16965 INSTRUMENTAL ACTIVATION ANALYSIS USING HIGH-RESOLUTION γ-SPECTROMETRY AND AUTOMATED DATA ANALYSIS. Biloen, P.; Dorrepaal, J.; van der Heijde, H. B. (Koninklijke/Shell Laboratorium, Amsterdam). Anal. Chem.; 45: No. 2, 288-292(Feb 1973).

A nondestructive method of instrumental activation analysis using a Ge(Li) detector is described, whose procedure is independent of sample type. It produces an estimated precision for any one element detected and calculates maximum concentrations of the undetected elements. In an average sample, six to nine concentrations and approximately thirty maximum concentrations are determined simultaneously. Only a few criteria are sufficient for a fully automated data analysis, which includes screening for systematic errors. The performance of this method of analysis can be accurately predicted from detector characteristics and isotope constants. (auth)

16966 EXPERIMENTAL TREATMENT OF NEUTRON SELF-SHIELDING IN NEUTRON ACTIVATION SPECIMENS, IN IMPURITY DETERMINATIONS IN SOME BORON-CONTAINING MATERIALS. Yankovskaya, T. A.; Usmanova, M. M.; Sadykov, S. A. This paper was summarized in At. Energ. (USSR); 31: No. 5, 508-509(Nov 1971) as paper No. 539/5542. (In Russian).

Full copy of this paper is held by TIC.

Absorption of neutrons in a matrix is one of the principal sources of error in neutron activation analysis of impurities present in neutron-absorbing materials, boron-containing materials included. In an effort to find a way to minimize the errors due to self-absorption of neutrons a method was explored of treating neutron absorption by experimentally determining the self-shielding factor in neutron activation of specimens artificially fabricated from boron-containing material. The method described was applied to the study of the effect of neutron self-shielding in boric acid specimens, for the determination of such impurities as Mg, Al, Si, Cl, Ca, Ti, V, Cr, Mn, Fe, Co, Cu, Zn, Mo, Ag, Ta, W, and Au. (DHM)

16967 RAPID RADIOCHEMICAL SEPARATION OF COPPER(II) BY REDUCTION AND ADSORPTION ON MERCURY. Brand, J.; Haerdi, W. (Univ., Geneva). Anal. Chim. Acta; 63: No. 1, 139-146(Jan 1973). (In French).

Theoretical and experimental studies were made on the separation of trace amounts of copper by reduction and adsorption on mercury metal in thiocyanate media. This method was studied experimentally with the radioisotope ^{64}Cu and is based on the adsorption of the Cu(I)–SCN complex. The factors limiting the extractions are described. There is a competitive adsorption between the complexes of CuSCN and $Hg(SCN)_2$ under certain conditions. The method can be applied in fast radiochemical separations for copper contents in the range 10^{-5} to 10^{-9} g ml^{-1}. (auth)

16968 LITHIUM NUCLEAR MICROPROBE. Padawar, G. M. U. S. Patent 3,710,113. 9 Jan 1973. Filed date 31 Aug 1970. 6p.

A beam of lithium ions (^7Li) is accelerated and bombarded against the surface of a target material containing hydrogen atoms at sufficient energy to stimulate an $^1H(^7Li,\gamma)^8Be$ radiative capture reaction and the intensity of the resulting emission of capture gamma rays is directly proportional to the number of hydrogen nuclei (protons) in the target material at a particular depth. The $^1H(^7Li,\gamma)^8Be$ reaction occurs only within a very narrow range of relative velocities between the lithium and hydrogen nuclei and, consequently, within a very narrow region inside the target material, permitting the concentration of hydrogen in solids to be measured at selected depths by varying the bombarding energy of the lithium ions. (Official Gazette)

16969 ACTIVATION ANALYSIS BY PHOTONEUTRON COUNTING. Mani, K.P.; Sankar Das, M. (Bhabha Atomic Research Centre, Bombay). Indian J. Technol.; 10: No. 6, 218-220(Jun 1972).

The photoneutron counting method was applied for the determination of gallium as well as for the estimation of manganese and sodium in some metallurgical and archaeological samples. The sample is irradiated in a nuclear reactor and then kept surrounded by a light element like deuterium. The gamma photons emitted by the radioactive nuclides in the sample, of energies greater than 2.23 MeV, give rise to secondary neutrons by the $^{2}H_{1}$ (γ, n) $^{1}H_{1}$ reaction. These secondary neutrons after thermalization are counted by BF_3 counters. (auth)

16970 DETERMINATION OF MACRO- AND TRACE AMOUNTS OF LANTHANUM IN PRASEODYMIUM OXIDE BY NEUTRON ACTIVATION ANALYSIS. Dybczynski, Rajmund; Sterliński, Slawomir (Inst, of Nuclear Research, Warsaw). Chem. Anal. (Warsaw); 17: No. 5-6, 1275-1289(1972). (In Polish).

Various analytical procedures for the determination of both macro- and trace amounts of lanthanum in praseodymium oxide by neutron activation analysis are elaborated. Nondestructive spectrometry with scintillation NaI(Tl) detectors was used for the determination of macro amounts of lanthanum. The precision of determination depended considerably upon the method used for the evaluation of digital data from pulse height analyser, and improved in the series; classical Covell's method, Sterliński's method, and SONA computer program. Lanthanum content that could be determined by this method ranged from several per cent down to 5×10^{-3}%. Trace amounts of La were determined both nondestructively by high resolution γ spectrometry with Ge(Li) detector and by radiochemical method in which lanthanum traces were isolated by ion exchange chromotography and finally determined by gamma ray spectrometry with NaI(Tl) detector. Radiochemical method was found to be more accurate and precise. Lower limit of detection was estimated to be approximately 7×10^{-6}%. (auth)

16971 APPEARANCE OF LOW-LEVEL RADIOACTIVE SILVER ON THE WORLD SILVER MARKET. Lindner, L.; Brinkman, G.A.; Schimmel, A. (Institut voor Kernphysisch Onderzoek, Amsterdam). Nature (London); 240: No. 5382, 463-464(22 Dec 1972).

An examination was made of a number of bars of Ag of East European origin for their radioactivity level; the bars were engraved with the number 1971, presumably referring to the year of manufacture. High resolution γ-ray spectroscopy of the bars revealed lines of ^{108m}Ag and ^{110m}Ag, with a specific activity averaging 0.084 ± 0.010 μCi ^{110m}Ag/kg Ag. The activity appeared to be distributed homogeneously throughout the bar. The ^{110m}Ag activity for bar ranged from 0.9 to 1.8 μCi, and the ^{108m}Ag activity was ~1.4 of the ^{110m}Ag. The results indicated that the Ag in the bars had been subjected to neutron irradiation during early 1969. Possible causes of the radioactivity are discussed, including the possibility that the deposits from which the Ag ore was derived were mined by underground nuclear explosion. The level of radioactivity was well below the legal unrestricted safe handling level. (UK)

16972 N-BENZOYL-N-PHENYLHYDROXYLAMINE AS A SUBSTOICHIOMETRIC EXTRACTANT IN ACTIVATION ANALYSIS. Determination of Tin. Tejam, B. M.; Haldar, B. C. (Inst. of Science, Bombay). Radiochem. Radioanal. Lett.; 13: No. 1, 25-32 (30 Jan 1973).

A simple method was developed for the determination of traces of tin in biological and geological materials by neutron activation and substoichiometric extraction with N-benzoyl-N-phenylhydroxylamine in chloroform using ^{121}Sn. Two samples and one standard can be analyzed in less than one hour after the dissolution of the samples. As low as 0.03 μg of tin can be estimated with an accuracy higher than 7%. (auth)

16973 SEPARATION OF ^{15}O BY FUSION IN SULFUR. Application to (γ,n) Activation Analysis of Oxygen in Selenium. Gosset, J.; Engelmann, C. (CEN de Saclay, Gif-sur-Yvette, France). Radiochem. Radioanal. Lett.; 13: No. 1, 39-53 (30 Jan 1973). (In French).

An ^{15}O separation method using the principle of reduction by sulfur was developed in order to determine oxygen by γ photon activation. Various parameters were studied and curves showing their influence on the separation yield are presented. The method was applied to the determination of oxygen in selenium after activation with bremsstrahlung of maximum energy 40 MeV, and concentrations of about 1 μg/g were measured. The detection limit is 0.05 μg/g for this energy and a beam intensity of 50 μA, the total analysis time being no longer than 6 min. (auth)

16974 EXTRACTION CHROMATOGRAPHIC SEPARATION OF ^{239}Np FROM FISSION AND ACTIVATION PRODUCTS IN THE DETERMINATION OF MICROGRAM AND SUBMICROGRAM QUANTITIES OF URANIUM. Wehner, H.; Al-Murab, S.; Stoeppler, M. (Kernforschungsanlage, Juelich, Ger.). Radiochem. Radioanal. Lett.; 13: No. 1, 1-6 (30 Jan 1973).

A simple technique for the extraction (or reversed phase) chromatographic separation of ^{239}Np from fission and activation products after neutron irradiation of the sample on porpak Q impregnated with TTA–o-xylene is described in detail. (auth)

16975 LIMITS OF DETECTION IN NEUTRON ACTIVATION ANALYSIS OF CONVEYOR-TRANSPORTED SUBSTANCES. Markun, N. Yu.; Shtan, A. S. (All-Union Scientific Research Inst. of Radiation Tech., Moscow). Radiochem. Radioanal. Lett.; 13: No. 1, 55-61(30 Jan 1973).

Limit of detection as an important criterion for characterizing the potentialities and perspectives of applying neutron activation analysis to conveyor-transported substances is discussed in detail. (auth)

16976 DETERMINATION OF ANTIMONY IN ROCKS BY NEUTRON ACTIVATION USING A Ge(Li)-SPECTROMETER. Zaitsev, E. I.; Skakodub, V. A.; Stoskov, Yu. P. (Inst. of Mineralogy, Geochemistry, and Crystallochemistry of Rare Elements, Moscow). Zh. Anal. Khim.; 27: No. 10, 2055-2058(Oct 1972). (In Russian).

A possibility was shown for determining antimony in rocks and minerals with the use of serial Ge(Li)-detectors. The method enables 20 to 30 determinations to be performed during a shift. The sensitivity achieved is 2 to 3×10^{-5}%. (auth)

16977 ACTIVATION METHOD FOR SIMULTANEOUS DETERMINATION OF Fe, Zn, AND Se IN MINERALIZED WATERS. Sharipov, E. B.; Abdullaev, A. A.; Zhuk, L. I.; Khasanov, A. S. (Inst. of Nuclear Physics, Kiev). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 62(1972). (In Russian).

An instrumental, neutron activation method was developed for the simultaneous assay of Fe, Zn, and Se in mineralized natural waters containing heavy concentrations of Ca, Na, K, Mg, Mn, Mo, Ti, and other metals. The method was based on the long-lived isotopes ^{65}Zn, ^{59}Fe, and ^{75}Se, and utilized Fe, Zn, and Se standards (10^{-6} g) in a simultaneous irradiation with a flux of 1.8×10^{13} n/cm^2 · sec. The method is capable of 8 to 10 samples/hr. (KSW)

16978 DETERMINATION OF MOLYBDENUM IN STANDARD ROCKS AND IN SCHEELITE ORES. Activation Analysis by Extraction of Daughter Nuclides. Alian, A.; Born, H. J.; Staerk, H. (Technical Univ., Garching, Ger.). Radiochim. Acta; 18: No. 1, 50-57(Dec 1972).

A procedure was developed for the separation of ^{99m}Tc activities from ^{99}Mo and other radionuclides produced as a result of rock irradiation in the pile, as well as from fission products. This procedure consists in the preliminary extraction of ^{99}Mo by 50% HDEHP from 7 M HNO_3, scrubbing the organic phase, reextraction of the accumulated ^{99m}Tc and purification of the latter by extraction with fresh solvent. The procedure was applied for the activation analysis of molybdenum in the standard rocks GR and PCC-I and in 11 Scheelite Ore samples from the Alps. A correction was made for the error resulting from the production of ^{99}Mo from uranium fission and the corrected values were found to be similar to the values obtained from the epithermal neutron activation analysis of molybdenum. The presented separation approach can be extended to other mother-daughter nuclides and to the activation analysis of the corresponding elements. (auth)

16979 PRINCIPLES AND APPLICATIONS OF NEUTRON ACTIVATION ANALYSIS. Nagorny, Klaus; Zietlow, Klaus (Univ., Hamburg). Chem.-Ing.-Tech.; 44: No. 21, 1201-1206(Nov 1972). (In German).

Neutron activation analysis has gained increasing importance both in industry and in research as a result of the use of sealed-off neutron tubes. A discussion of the physical principles of neutron activation analysis is followed by a description of a complete assembly that can be used for routine analysis and for research purposes. Fundamental questions regarding the determination of nitrogen by activation analysis are discussed and the possible applications of this technique to other elements are outlined. (auth)

Chemical and Spectral Procedures

Refer also to abstract 17478.

16980 (BARC-621) CARRIER DISTILLATION METHOD FOR THE ESTIMATION OF NON-RARE EARTH IMPURITIES IN Y_2O_3. Naik, R.C.; Karnik, K. P. D. (Bhabha Atomic Research Centre, Bombay, India). 1972. 15p. Dep. NTIS. (U.S. Sales Only).

A dc arc spectrographic method is reported for the determination of sixteen common metallic impurities in Y_2O_3. The method consists of a carrier distillation technique with a mixture of NaF, AgCl, and graphite (1:4:5) as carrier. Working curves are drawn for twelve of the impurities, viz. Fe, Cu, Mg, Mn, Si, Al, Cr, Sn, Ni, B, Ca, and Pb using Co-3044.00 Å and Bi-2897.97 Å lines as internal standards. A semiquantitative estimation is made of the

impurities Cd, Sb, and Ga. The limits of detection vary from 0.1 ppM to 50 ppM depending on the impurity element, while the higher limit of estimation is 100 ppM for all the elements. Zn is detected only at 100 ppM level. (auth)

16981 (BARC-622) DETERMINATION OF TRACES OF CHROMIUM IN PURE THORIUM. Krishnan, V.N.; Mahajan, L.M. (Bhabha Atomic Research Centre, Bombay, India). 1972. 6p. Dep. NTIS. (U.S. Sales Only).

A method is described for the spectrophotometric determination of chromium in nuclear pure thorium samples. Chromium present in the sample is oxidized with boiling perchloric acid and later determined by its color with S-diphenylcarbazide spectrophotometrically at a wave length of 540 mn in a 10 mm cell. Chromium can be determined down to less than 5 ppM in nuclear pure thorium samples by this method. (auth)

16982 (CEA-R-4364) RESULTS OF AN INTERLABORATORY COMPARISON OF THE ANALYSIS OF Pu. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1972. 24p. (In French). Dep. NTIS (U. S. Sales Only).

An interlaboratory comparison of determinations made of 11 elements in a sample of Pu is presented. The comparison was made in order to verify the applicability of the methods (emission spectroscopy, absorption spectrophotometry, and polarography) employed and the quality of the sample used. The results obtained for each element and the regrouped results demonstrate, in general, a satisfactory agreement between the participating laboratories. The standard deviations are given for the various elements. However further work is required for Al and Si. (France)

16983 (CSIRO-Trans-11142) ISOTOPIC ANALYSIS OF NITROGEN BY OPTICAL SPECTROMETRY, FOR LOW ^{15}N CONTENTS. Leicknam, J. P.; Middelboe, V.; Proksch, G. D. Translated by D. R. Eddy from Anal. Chim. Acta; 40: 487–502 (1968). 11p. Dep. NTIS (U. S. Sales Only).

For mixtures of $^{14}N_2$ and $^{14}N^{15}N$ low in ^{15}N (isotopic abundances less than 2%), previous optical spectrometric methods do not produce rapid results of sufficient precision. Operating conditions are described for the determination of the isotopic content to ±3% near the natural abundance and to ±1% when the sample contains an atom ratio of ^{15}N: ^{15}N of 1.5: 100. The time required for a determination is ca. 10 min. A spectrometer is modified by the substitution of an exit slit and a photomultiplier in place of a photographic plate. The excitation of the electrodeless discharge tube is made by a high-frequency field. The method has been applied to samples of ammonium salts, fertilizers and plant material. In all cases, the precision of the isotopic measurements was greater than that required for most agricultural studies (5 to 6%). (auth)

16984 (RT/CHI–(72)10) DETERMINATION OF METALLIC IMPURITIES IN HIGHLY ENRICHED URANIUM SOLUTIONS BY ATOMIC ABSORPTION WITH PRIOR SEPARATION OF THE URANIUM BY CHROMATOGRAPHIC PARTITION. Pagliai, V.; Pozzi, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 13 May 1972. 17p. (In French). Dep. NTIS (U. S. Sales Only).

A method is presented for the determination of several metallic impurities (Al, Ca, Cd, Cu, Fe, Li, Mg, Na, and Ni) in highly enriched solutions of uranyl nitrate from the EUREX plant for the reprocessing of irradiated fuels. First, the uranium matrix is eliminated by means of reversed phase chromatography (stationary phase is 100% TBP on Kel-F), and then the eluate containing the impurities is analyzed by means of a Perkin–Elmer Model 303 atomic absorption spectrophotometer. The method is simple and rapid, and it makes it possible to determine impurities in enriched uranium solutions without the difficulties of remote operation of the equipment. (tr-auth)

16985 (RT/CHI-(72)16) SEPARATION AND DIRECT MEASUREMENT OF MICRO–MACRO QUANTITIES OF URANIUM IN PROCESS EFFLUENT. Canonico, A.; Pompei, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 11 Oct 1972. 27p. (In Italian). Dep. NTIS (U. S. Sales Only).

A liquid–liquid TBP 30% in hexone extraction procedure is described for the separation and direct spectrophotometric determination of uranium as thiocyanate in the organic extract. The method is applicable to the determination of microgram to milligram amounts of uranium in the presence of large quantities of diverse ions and is especially suitable for the separation and determination of uranium from ITREC reactor fuel element reprocessing solutions. (auth)

16986 APPLICATION OF A WAVELENGTH SCANNING TECHNIQUE TO MULTI-ELEMENT DETERMINATIONS BY ATOMIC FLUORESCENCE SPECTROMETRY. Norris, J. D.; West, T. S. (Imperial Coll. of Science and Tech., London). Anal. Chem.; 45: No. 2, 226-230(Feb 1973).

Two dual-element electrodeless discharge lamps, operated from a single microwave generator via a twoport power divider, enable a separated air–acetylene flame to be illuminated with the intense resonance radiation of four elements. The resultant atomic fluorescence may be rapidly measured by scanning over the appropriate wavelength range. Results obtained for the sequential multi-element determination of zinc, cadmium, nickel, and cobalt show that the sensitivity and selectivity are the same by the scanning technique as by conventional atomic fluorescence spectrometry. Wavelength scans are also given for nickel, cobalt, iron, and manganese, and for selenium, tellurium, nickel, and cobalt combinations. (auth)

16987 ATOMIC ABSORPTION DETERMINATION OF NANOGRAM QUANTITIES OF TELLURIUM USING THE SAMPLING BOAT TECHNIQUE. Beaty, R. D. (Univ. of Missouri, Rolla). Anal. Chem.; 45: No. 2, 234-238(Feb 1973).

A method for the determination of ultra-trace quantities of tellurium was developed, utilizing the sampling boat technique of atomic absorption. Two procedures were developed for the chemical separation of tellurium. In some types of samples, the tellurium can be directly extracted from 4M HCl solution into methyl isobutyl ketone. The relative standard deviation obtained for a typical sample treated in this manner and analyzed by atomic absorption was 5.0%. In samples where other constituents cause chemical interference with the extraction, a preliminary separation of tellurium by coprecipitation with selenium was employed. The relative standard deviation using this procedure increases to 6.6%, but few interferences are observed. Linear response occurs for a range of 5 to 100 ng tellurium. (auth)

16988 EXTRACTION— PHOTOMETRIC DETERMINATION OF THORIUM WITH CHLOROPHOSPHONAZO-III. Yamamoto, T. (Japan Atomic Energy Research Inst., Tokai). Anal. Chim. Acta; 63: No. 1, 65-70(Jan 1973).

A simple and rapid spectrophotometric determination of thorium is described. The thorium–chlorophosphonazo-III complex is extracted into 3-methyl-1-butanol from 2.0 to 3.0 M hydrochloric acid solution. Maximum absorbance occurs at 620 and 670 nm and Beer's law is obeyed at the latter wavelength over the range of 0 to 15 μg per 10 ml of the organic phase. The molar absorptivity is $12.2 \cdot 10^4$ l mole^{-1} cm^{-1} at 670 nm. Thorium can be determined in the presence of fluoride, oxalate, sulfate, and EDTA. Many common cations do not interfere, but uranium, zirconium and niobium interfere seriously. (auth)

16989 DETERMINATION OF GOLD, PLATINUM GROUP METALS, AND SOME COMMON METALS IN NATIVE SILVER BY ATOMIC ABSORPTION SPECTROMETRY. Sen Gupta, J. G. (Geological Survey of Canada, Ottawa). Anal. Chim. Acta; 63: No. 1, 19-28(Jan 1973).

The precipitation of silver acetylide prevented analysis of native silver with the air–acetylene flame. Air–hydrogen and air–propane flames were insufficiently sensitive for the determination of the platinum group metals. This difficulty was overcome by separating the silver as silver chloride by double precipitation, and determining the noble and common metals in the filtrate by atomic absorption. The analytical data on the noble metals (ppM range) and common elements in three Canadian native silver samples are presented. (auth)

16990 MERCURIC IODATE AS AN ANALYTICAL REAGENT. Spectrophotometric Determination of certain Anions by an Amplification Procedure Employing the Linear Starch Iodine System. Hinze, W. L.; Humphrey, R. E. (Sam Houston State Univ., Huntsville, TX). Anal. Chem.; 45: No. 2, 385-388(Feb 1973).

The absorption of the starch–iodine complex was employed for the spectrophotometric determination of bromide, chloride, cyanide, iodide, sulfide, sulfite, thiocyanate, and thiosulfate. The rather high molar absorptivity of the starch–iodine chromogen combined with the chemical "amplification" involved in the reaction results in spectrophotometric methods useful for the measurement of the anions involved in the very low parts per million range. (DHM)

16991 DETERMINATION OF OXYGEN IN MOLYBDENUM BY THE INERT GAS FUSION METHOD USING A LIMITED PLATINUM BATH. Pauwels, J. (Commission of European Communities, Brussels); Kahles, A.; Kraft, G. J. Less-Common Metals; 30: 173-6(1973).

An inert gas fusion method using only a 0.94 : 1 platinum to molybdenum ratio instead of the more usual 10 : 1 ratio was developed. In addition to its economical advantage, this method also has greater sensitivity, precision, and accuracy. As molybdenum often contains oxygen concentrations of only a few ppM, high bath-to-metal ratios may have an adverse influence on sensitivity and pre-

cision, because they involve the use of smaller samples and the danger of high blanks when a sandwich-technique is used. (auth)

16992 SPECTROPHOTOMETRIC DETERMINATION OF Al(III), Ce(IV), AND U(VI) USING SOLOCHROME AZURINE BS. Sharma, C.L.; Tandon, S.N.; Rai, Dilbagh; Sabharwal, A. K. (Roorkee Univ., India). Indian J. Chem.; 10: No. 7, 744-745(Jul 1972).

A simple, rapid and sensitive method is proposed for the spectrophotometric determination of trace amounts of aluminium, uranium, and cerium in aqueous medium using solochrome azurine BS. Beer's law is obeyed over the range of 0.0 to 5 mg/litre of aluminium with molar absorptivity of 8880 at 560 nm and over the range of 1.0 to 15 mg/litre of uranium with molar absorptivity of 22500 at 600 nm and over the range of 2.8 to 11 mg/litre of cerium with molar absorptivity of 11220 at 505 nm. The mean sensitivity for Al(III), U(VI), and Ce(IV) complex is 0.03, 0.297, and 0.071 $\mu g/cm^2$/0.005 absorbance unit. The stability constant for 1 : 2 [Al(III) : dye] complex is 5.55×10^8, for 1 : 1 [U(VI) : dye] complex 2.06×10^4 and for 1 : 2 [Ce(IV) : dye] complex 3.89×10^5. The interference of foreign ions was also studied. (auth)

16993 LIQUID-LIQUID EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) WITH THIOTHENOYLTRIFLUOROACETONE. Solanke, K.R.; Khopkar, S.M. (Indian Inst. of Tech., Bombay). Chem. Anal. (Warsaw); 17: No. 5-6, 1175-1182(1972).

1,1,1-Trifluoro-4-(2-thienyl)-4-mercapto-but-3-en-2-one (STTA) that is thio-substituted derivative of 2-thenoyltrifluoroacetone was used for simultaneous extraction and direct spectrophotometric determination of uranium(VI). Thus about 360 μg of uranium can be quantitatively extracted with a mixture of 7 ml of 0.001 M of STTA in carbon tetrachloride and 3 ml of butyl acetate in the pH region of 5.5 to 6. The absorbance of the orange colored complex was measured at a wavelength of 490 nm. The system fulfills Beer's law in the concentration range of 4.5 to 54 μg of uranium(VI) per ml. The complex is stable for at least 120 hours. Salting-out agents have no significant effect on the process of extraction. Extraction was quantitative within 10 min of equilibration. Higher concentrations of reagent have negligible effect in enhancing extraction. Uranium can be quantitatively extracted and determined in the presence of a large number of elements. (auth)

16994 COLORIMETRIC DETERMINATION OF SMALL AMOUNTS OF IODIDE, IODATE, AND PERIODATE IONS WITH 4-BROMO-N,N′-DI(β-HYDROXYPROPYL)-o-PHENYLENEDIAMINE. Paslawska, Stefania (Academy of Medicine, Danzig). Chem. Anal. (Warsaw); 17: No. 5-6, 1267-1273(1972). (In Polish).

The method consists in measurement of absorbance of the colored product of oxidation reaction that occurs between 4-bromo-N,N′-di-(β-hydroxypropyl)-o-phenylenediamine (BrDHPF) and iodine in a solution of pH = 2. The colored compound shows maximum absorbance at λ = 530 nm. Molar absorptivity of molecular iodine amounts to 110,000 for the determination of iodides and iodates and 126,000 for periodates respectively. Beer's law was obeyed in the concentration range of 0.5 to 2.0 μg I/cm^3 (iodides and iodates) and 0.03 to 1.5 μg I/cm^3 (periodates) respectively. The method enables the determination (in the medium of pH = 2) of iodates and periodates, as well as iodides after their oxidation with bromine water. The solution of cadmium iodide was applied for the isolation of free iodine. This solution bound at the same time the excess of iodide ions into stable complex. The determination should be carried out in solutions which do not contain other ions that act as oxidants e.g., Ag^+, Fe^{3+}, Cu^{2+}, Ce^{4+}, Sb^{5+}, $[Fe(CN)_6]^{3-}$, $Cr_2O_7^{2-}$, which yield color reactions with the reagent. The temperature in the range of 288 to 303°K has no effect on the determination. The method was used for the determination of iodine in the air samples. (auth)

16995 USE OF N-CINNAMOYLPHENYLHYDROXYLAMINE IN ANALYTICAL CHEMISTRY. Communication 6. Precipitation and Separation of Gallium. Kulumbegashvili, V. A.; Ostroumov, E. A. (Inst. of Oceanology, Moscow). Zh. Anal. Khim.; 27: No. 10, 1929-1933(Oct 1972). (In Russian).

Gallium is quantitatively precipitated with N-cinnamoylphenylhydroxylamine from hydrochloric or sulfuric acid solutions at pH 2. Optimum conditions for the precipitation were found. A light-yellow metal chelate, $Ga(C_{15}H_{12}O_2N)_3$, is precipitated. A method was developed for the separation of gallium from Mn, Ni, Co, Zn, Be, Cr, rare earth elements, and Y. The method enables the complete separation and gravimetric determination using single-stage precipitation. (auth)

16996 DETERMINATION OF SCANDIUM IN CATALYSTS FOR AMMONIA SYNTHESIS BY THE ATOMIC ABSORPTION SPECTRAL METHOD. Talalaev, B. M.; Tarasevich, N. I.; Kogan, A. A. Zh. Anal. Khim.; 27: No. 10, 1952-1955(Oct 1972). (In Russian).

The light sources of two types for determining scandium were studied. Some peculiarities of the atomic absorption determination of scandium was investigated and a method for its determination (1 to 3%) in catalysts of the ammonia synthesis was developed. The reproducibility of the results is 3.5%. (auth)

16997 REACTION OF LANTHANUM SALTS WITH CRESOLPHTHALEXONE AND CETYLPYRIDINIUM BROMIDE. Poluektov, N. S.; Lauer, R. S.; Ovchar, L. A. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 27: No. 10, 1956-1959(Oct 1972). (In Russian).

Lanthanum ions interact with cresolphthalexon and cetylpyridinium bromide with the formation of blue colored products; Ce, Pr, Nd ions give a more weak reaction, ions of other rare earth elements do not interact with the reagents. A ratio of the components is La : CP(CPyr)$_2$ = 1 : 2. A photometric method was developed for determining lanthanum in a mixture of La_2O_3 and Nd_2O_3. The sensitivity of the method is 1%. (auth)

16998 USE OF COULOMETRY AT A CONTROLLED POTENTIAL FOR DETERMINING URANIUM AND SOME TRANSURANIUM ELEMENTS (A REVIEW). Sklyarenko, I. S.; Mikhailov, V. M.; Chubukova, T. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 27: No. 10, 1991-2003 (Oct 1972). (In Russian).

The literature on the method of coulometry at a controlled potential, used for determining uranium and transuranium elements, is reviewed. (auth)

16999 POTENTIOMETRIC AND PHOTOMETRIC DETERMINATION OF RUTHENIUM AS RUTHENATE. Norkus, P. K.; Yankauskas, Yu. Yu. (Inst. of Chemistry and Chemical Tech., Vilnyus, USSR). Zh. Anal. Khim.; 27: No. 10, 2014-2019(Oct 1972). (In Russian).

Conditions for quantitative turning compounds of ruthenium of different oxidation states into ruthenate were found. Methods were suggested for determining ruthenate in an alkaline medium by the potentiometric titration with arsenite or spectrophotometrically at 465 nm. The catalysis of the bromate decomposition of hypobromite and the decomposition of H_2O_2 in an alkaline medium was observed. (auth)

17000 STUDY OF HEXYLDIANTIPYRYLMETHANEPYROCATECHOL COMPLEXES OF MOLYBDENUM(VI) AND TUNGSTEN(VI) AND THEIR ANALYTICAL APPLICATION. Shnaiderman, S. Ya.; Gumen, A. S. (Kiev Polytechnic Inst.). Zh. Anal. Khim.; 27: No. 10, 2060-2064(Oct 1972). (In Russian).

The formation of hexyldiantipyrylmethanepyrocatechol complexes of molybdenum(VI), and tungsten(VI) was studied. Optimum conditions for the interaction were found: 800- to 1000-fold excess of pyrocatechol, 10-fold excess of hexyldiantipyrylmethane, pH 1.5 and 2.0 for W(VI) and Mo(VI) respectively. The composition of the complexes was established: Me : H_2Bz : H-Diant = 1 : 1 : 1 and 1 : 2 : 1. The solid compounds were isolated and studied by ir spectroscopy. The structure of the compounds is suggested. An extraction-photometric method was developed for determining Mo(VI) and W(VI) in their mixture. (auth)

17001 VISTAS IN ANALYTICAL CHEMISTRY. A COMMEMORATION VOLUME IN HONOUR OF PROFESSOR G. GOPALA RAO. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971). 417p. Rs. 50.00.

Separate abstracts were prepared for nine of the nineteen chapters. (DHM)

For abstracts of individual chapters see: 16953—16955, 17002—17004, 17024, 17025, and 17132.

17002 RECENT TRENDS IN ANALYTICAL ATOMIC ABSORPTION SPECTROSCOPY. Slavin, W.; Slavin, S. (Perkin-Elmer Corp., Norwalk, CT). pp 73-101 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

A review is presented on recent trends in atomic absorption spectroscopy that includes a table of detection limits (μg/ml) for 69 elements. (DHM)

17003 COMPLEXOMETRIC TITRATIONS. Cheng, K. L. (Univ. of Missouri, Kansas City). pp 223-265 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

Topics considered in a review of complexometric titrations are: titrants, theory, masking, methods of detecting end point(colorimetric and potentiometric methods), methods of titration, improvement of selectivity, nonaqueous complexometry, recent advances, and future research. (DHM)

17004 ADVANCES AND PROBLEMS OF THE KINETIC METHODS OF ANALYSIS. Yatsimirskii, K. B. (Inst. of Inorganic and General Chemistry, Kiev). pp 335-342 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

Catalytic reactions used for the determination of one or another elements are referred to as indicator reactions. More than half of the elements of the periodic chart can be determined using indicator reactions. The mechanisms of catalytic reactions and problems in kinetic methods of analysis are considered. (DHM)

17005 DETERMINATION OF MOLYBDENUM(VI) AND O-DIPHENOLS BY HIGH FREQUENCY TITRATIONS. Soni, R. N.; Nahata, J. S. (Birla Inst. of Tech. and Science, Pilani, India). Indian J. Chem.; 10: No. 4, 446-447(Apr 1972).

Molybdenum(VI) forms orange colored 1:2 complexes (metal:ligand) with pyrogallol, catechol, 2,3-dihydroxynaphthalene, 2,3-dihydroxynaphthalene-6-sulfonic acid, catechol monosulfonic acid, catechol disulphonic acid (tiron), pyrogallol carboxylic acid, and gallic acid as revealed by high frequency titrations. Procedure for the estimation of Mo(VI) in neutral solution is also described. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 17418, 17421, 17593, 17929, 18765, and 18970.

17006 (ITJ-18) RADIOMETRIC METHOD OF THE DETERMINATION OF CALCIUM AND IRON IN CEMENT RAW MIX. Gorski, L.; Lubecki, A.; Ostachowicz, J.; Wasilewska, M.; Kurdowski, W.; Lankosz, M.; Molodynska, W.; Osiowski, A. (Institute of Nuclear Techniques, Krakow, Poland). 1972. 91p. (In Polish). Dep. NTIS. (U.S. Sales Only).

The nondispersive x-ray fluorescence method with the ^{109}Cd radioisotope source was applied for a rapid industrial and for "on-stream" determination of Ca and Fe in cement raw mix. The total error of the analysis was calculated, resulting ± 0.2% CaO for the range of 46 to 51% CaO and ± 0.05 % Fe_2O_3 for the range 0.9 to 3.0% Fe_2O_3. The error was estimated at the probability level 0.95. The time necessary for the determination of both elements is 2 minutes. The rapid industrial method was tested in a cement plant "Nowa Huta" for two different kinds of cement raw mix, containing either blast-furnace-slog or fly ashes. (auth)

17007 (SC-DR-720519-A) ANALYSIS OF AN ALUMINA-CONTAMINATED ERBIUM-KOVAR INTERFACE USING ION MICROPROBE TECHNIQUES. Guthrie, J. W. (Sandia Labs., Albuquerque, N. Mex). Dec 1972. 17p. Dep. NTIS.

This report describes the ion microprobe analysis of an alumina-contaminated interface between thin film erbium hydride and Kovar for samples prepared by neutron tube target fabrication processes. The processing procedure used for cleaning and roughening the Kovar substrate is identified as the source of the contamination. (auth)

17008 DETERMINATION OF URANIUM DISTRIBUTIONS IN TERRESTRIAL AND LUNAR ROCKS BY MEANS OF FISSION TRACK AND MICROPROBE TECHNIQUE. Thiel, K.; Herr, W. Kerntechnik; 14: No. 11, 513-518(Nov 1972). (In German and English).

A fission track method for determining the distribution of uranium is described that consists of irradiating the uranium-containing substance with thermal neutrons and placing this substance in close contact in other an appropriate detector foil ("Lexan" polycarbonate or mica) so that part of the fission products will penetrate into the detector and will leave so-called fission tracks. The latent tracks can be brought out by an appropriate etching technique, and can then be counted under a microscope. For quantitative uranium determination an appropriate reference standard is also placed on the detector foil and is irradiated together with the sample. The fission track method makes it possible to determine uranium contents down to 10^{-3} ppM range over areas of less than 10^{-6} cm^2. Uranium contents were determined in groundmass and residual melt in terrestrial basalts and in lunar basalts. (DHM)

17009 NEW TITRIMETRIC METHOD: THERMORADIOMETRIC TITRATION. Toelgyessy, Juraj; Lesny, Juraj (Slovak Technical Univ., Bratislava). Jad. Energ.; 19: No. 1, 28(Jan 1973).

The principle of thermoradiometric titration is the following: A radioactive inert gas is absorbed in an appropriate way in the solution titrated, or a solution containing a radioactive inert gas is added to the solution titrated. The titrant may be added to the solution titrated continuously or discontinuously. Due to the liberation of the reaction heat the solubility of the gas decreases and the radioactive inert gas releases. The radioactivity of the released inert gas or the decrease of the radioactivity of the solution titrated during titration may be measured and continuously recorded. The method may be applied to neutralization, precipitation, redox and complexometric titrations. Experiments have shown that the end-point can be detected sensitively and precisely. (DHM)

17010 COMPARISON OF LIQUID SCINTILLATION MIXTURES FOR THE ASSAY OF NICKEL-63 IN AQUEOUS MEDIUM. Law, J. J.; Smith, J. W.; Scott, M. W. (Longwood Coll., Farmville, VA). Anal. Biochem.; 50: No. 2, 635-8(Dec 1972).

The mixtures investigated included several dioxane- and toluene-based solutions, a gel scintillation system, and a suspended scintillator system. The activities of all samples were counted at ambient temperature in a liquid scintillation spectrometer equipped with photomultipliers and operated in a coincidence mode. Ready-Solv Solution VI offered the highest counting efficiency, (51.1 ± 0.3)%, and the best figure of merit. (MCG)

17011 ADVANTAGES OF THE USE OF CHERENKOV COUNTING FOR DETERMINATION OF ^{32}P IN PHOTOPHOSPHORYLATION RESEARCH. Gould, J. M.; Cather, R.; Winget, G. D. (Univ. of Cincinnati). Anal. Biochem.; 50: No. 2, 540-8(Dec 1972).

The technique described involves the use of a liquid scintillation spectrometer to assay Cherenkov radiation generated in the aqueous media by the high energy β-emissions of ^{32}P. This technique is insensitive to a wide range of representative compounds frequently used in photophosphorylation research. In addition, the less expensive polyethylene vials are superior to glass vials in counting efficiency. Cherenkov counting also offers other advantages, including increased counting efficiency, simplicity of sample preparation, and automatic sample handling. This counting method does have the drawback that the counting efficiency is lowered by substances producing a yellow color in the samples. It is possible, however, partially to alleviate this problem by using organic compounds to shift the wavelength of the emitted light. (auth)

17012 PREPARATION OF LIQUID SAMPLES BY OXIDATION AND A LIQUID SCINTILLATION SPECTROMETER APPLICATION. Reich, A. (to Intertechnique SA). French Patent 2,109,290. 26 May 1972. Filed 9 Oct 1970. (In French).

In this method for the preparation of liquid samples, the initial sample (organic or plant tissue containing ^{14}C labeled carbon or ^{3}H labeled hydrogen) is deposited on an oxidation catalyst traversed by a downward oxygen current. A heated duct (at a temperature sufficiently high to avoid retention) is used to continuously extract the combustion products from the base of the catalyst. The water and CO_2 are separately collected. The device possesses a furnace in which the oxidation catalyst is situated. This furnace is provided with an orifice at its upper end for the introduction of successive samples. Its lower end is provided with a duct connected to the means of selectively retaining the water and CO_2. A transporter receives the liquid samples coming from each initial sample and fills up the successive holes of the sample conveyor of a liquid scintillation spectrometer. (France)

17013 APPLICATIONS OF RADIOSOTOPE X-RAY FLOURESCENCE IN PROSPECTION, EXPLOITATION, AND PROCESSING OF MINERALS. Clayton, C.G. (Atomic Energy Research Establishment, Harwell, Eng.). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl.; No. 93, 4-13(1972). (In French).

The radiation detectors employed with radioisotope instruments for mineral analysis are reviewed. Two methods are proposed to overcome the effects due to the absorption and granulometry of the matrix. The factors which affect the accuracy of the measurements made on nonprepared rock surfaces are important in the case of drilling cores. Radioisotope x-ray fluorescence probes were developed for applications in deep and shallow drillings. Measurements effected on powdered rock samples are presented: Cu, Sn, and Ag ores. Continuous quality control is effected in the plants preparing the ores. Pilot scale studies have been carried out with a high precision and reproducibility for certain elements. Applications in the cement industry are cited: measurement of the Ca contents; measurement of the CaO/SiO_2 basicity ratio of material loaded into a furnace; measurements of ash in coal. (France)

17014 EXAMPLE OF HARD-WATER ERROR IN RADIOCARBON DATING OF VEGETABLE MATTER. Shotton, F. W. (Univ. of Birmingham, Eng.). Nature (London); 240: No. 5382, 460-461(22 Dec 1972).

It is stated that the "hard water effect" is a recognized source of error in radiocarbon dating. It causes ages to be over assessed and occurs when the material to be dated synthesises its skeleton under water and so uses bicarbonate derived from old inert sources. A study is described of a section of late Quarternary sediments from the northern tip of Jutland, expected to show a radiocarbon date 10,600 yr but not exceeding 12,000 yr. Consideration of the dates obtained showed a disturbing inconsistency, with several samples apparently much older than others below them. It was considered of interest to find a series of ^{14}C estimations that were divided into two series, one reliable and one not, each related to the type of material being assayed, and for

which the size of the hard water error could be roughly quantified. (UK)

17015 RADIOMETRIC METHOD FOR DETERMINATION OF MOLYBDENUM. Communication 1. The Method of Radiometric Correction With The Use of Substoichiometric Amounts of EDTA. Shamaev, V. I.; Martynov, A. M.; Staroverova, L. L. (Moscow Chemical-Technological Inst.). Zh. Anal. Khim.; 27: No. 10, 2058-2060(Oct 1972). (In Russian).

A method of radiometric correction for determining molybdenum was developed. The method includes the substoichiometric separation of molybdenum with EDTA followed by the precipitation of free molybdenum with 8-hydroxyquinoline. The precipitation of Mo(V) and Mo(VI) with an ethanol solution of oxine at different acidity of the medium was studied. (auth)

17016 LIQUID SCINTILLATION MEASUREMENT OF RADIOACTIVITY IN HARD TISSUE ABRASION SLURRIES. Conard, Gordon J.; Osborn, Judith C.; Hefferren, John J. (American Dental Association Research Inst., Chicago). J. Dent. Res.; 51: No. 5, 1501(1972).

Neutron-activated roots were the substrate for in vitro studies of dentifrice abrasivity. Liquid scintillation spectroscopy was used to measure insoluble radioisotopes in abrasion slurries. Efficiency correction factors were obtained by preparing synthetic brushing slurries. (MCG)

17017 RAPID METHOD OF DETERMINING Pu IN URINE BY X RAYS. DETECTION OF DAUGHTER ELEMENTS. LIMITATIONS OF THE METHOD. Ventadour, J.; Philippon, A. M.; Boulay, P.; Chivot, J. J. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). pp 287-302 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The determination of ^{239}Pu and its daughter isotopes in urine by α emission measurements involves tediously preparing the samples; the results only yield information about Pu. The x-rays emitted by the daughter products can be used for this determination. This method is superior to the previous method as the sample preparation is less tedious, an appreciable gain in time being obtained, and all the radionuclides present are preserved. The x-ray emission from Pu increases with the ^{240}Pu, ^{241}Pu, and hence ^{241}Am concentrations. The measurements are carried out with a large surface area xenon-methane proportional counter having a low background noise. (France)

17018 AUTOMATIC DETERMINATION OF TRITIUM FOR HEALTH PHYSICS INVESTIGATIONS. Gillet, R.; Regibeau, A. (Univ., Louvain, Belg.). pp 577-88 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

A practical procedure was established for estimating the tritium activity of air, contaminated liquids having been used for washing purposes, and of urine. The crude results corresponding to 420 samples are put on magnetic tape and treated sequentially on another computer (Digital PDP9) using a program edited in Fortran IV. This computer automatically subdivides the information such that the final results required for each particular type of analysis are presented in the appropriate manner. (France)

17019 DETERMINATION OF THE ISOTOPIC COMPOSITION OF URANIUM BY ALPHA SPECTROMETRY. Khan, A. H. (Pakistan Atomic Energy Commission, Karachi); Acena, M. L. Radiochim. Acta; 18: No. 1, 30-34(Dec 1972).

A simple method was developed to determine the isotopic composition of uranium in a series of standard sources by alpha spectrometry using silicon surface-barrier detectors. In this method, a semi-empirical relation, $F = f(A)$, has been derived to define the low-energy alpha tails. In this relation, F is the background of a peak due to the tail of an immediate higher-energy peak whose activity is A. In the range 20 to 60 μg U_3O_8/cm^2 of source thickness, the average standard deviation of the results varied from 4 to 8% for different isotopes. Within the same range of thickness, it was observed that the slope of the function, F, is significantly influenced by the degree of smoothness of the source surface. (auth)

Separation Procedures

17020 (RT/CHI-(72)13) SEPARATION OF RARE EARTHS FROM A MATRIX OF MIXED OXIDES OF URANIUM AND THORIUM BY MEANS OF SOLVENT EXTRACTION. Pompei, V.; Canonico, A.; Mastrofrancesco, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 10 Jul 1972. 54p. (In Italian). Dep. NTIS (U. S. Sales Only).

A method for the quantitative separation of rare earths from their nitric solutions is described, based on the solvent extraction of the rare earths. A simultaneous separation from the lanthanides of the common element impurities present in the mixed thorium–uranium oxides was accomplished. The method fulfills the requirements of accuracy, simplicity, and speed necessary for use in the routine determinations. It assures a good separation and purification of rare earths from thorium, uranium, corrosion and fission products and the apparatus can be easily remotized. (auth)

17021 EXTRACTION OF METAL-THIOCYANATE COMPLEXES. III. Rozycki, Cezary; Suszczewski, Waldemar (Inst. of General Chemistry and Inorganic Tech., Warsaw). Chem. Anal. (Warsaw); 17: No. 5-6, 1209-1217(1972). (In German).

The dependence of percent extraction of Ni, Sn(IV), Th, Sc, Be, Ba, Nd, Sm, and Er upon the concentration of thiocyanate and hydrogen ions was examined. Tri-n-butyl phosphate (TBP), methyl isobutyl ketone, isoamyl alcohol, isobutyl acetate, and 25% TBP solution in $CHCl_3$ were used as extractants. TBP was found to be the best. For each element the pH range, in which for a given NH_4SCN concentration the percent extraction is independent of pH, was determined. The data obtained can be used for the elaboration of separation methods. (auth)

17022 LABORATORY STUDIES OF THE PURIFICATION KINETICS OF RIVER WATER (ISERE) BY SEDIMENTARY SUSPENSIONS. CASE OF ^{51}Cr, ^{59}Fe, ^{60}Co, ^{85}Sr, ^{106}Ru, ^{137}Cs, ^{141}Ce, AND ^{203}Hg. Lachet, B. (CEN, Grenoble, France). Radioprotection; 7: No. 3, 143-157(1972). (In French).

The purification kinetics of water containing radionuclides by sedimentary suspension can be expressed by the following equation: $R = R(0)(1 + t/a)^n$, where a and n are two parameters determined by the least square method, and R(0) and R are the initial activity and the activity after a time t of the water. This fit appears to be satisfactory and highly significant in all the cases studied: sediments (screened (fine sands or silt) or unscreened in 1g/l or 20g/l); radionuclides (^{51}Cr, ^{59}Fe, ^{60}Co, ^{85}Sr, ^{106}Ru, ^{137}Sc, ^{141}Ce, and ^{203}Hg with or without a carrier in the form of a chloride, nitrate, citrate, acetate, nitrato-nitrosyl or EDTA). (France)

17023 INFLUENCE OF HAMMETT'S COEFFICIENTS ON DISTRIBUTION RATIO OF LANTHANIDE AND TRANSPLUTONIDE ION-PAIRS WITH ALIQUAT-336. Stronski, I.; Nahlik, E. (Inst. of Nuclear Physics, Krakow). Radiochim. Acta; 18: No. 1, 47-50 (Dec 1972).

The dependence of the distribution ratio D on the Hammett coefficients by liquid-liquid extraction of the salts of europium, americium, and curium was investigated by means of tricaprylmethylammonium nitrate as extracting reagent. An inverse relationship of the values of log D and σ was found. (auth)

17024 CATION AND SOLVENT EXCHANGE PROPERTIES OF SYNTHETIC ZEOLITES. Barrett, R. B.; Marinsky, J. A. (State Univ. of New York, Buffalo). pp 172-205 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

In this review an effort is made to show that the exchange of ions in a rigid but porous ion-exchange is controlled to a large extent by the nature of the internal environment of the exchanger which itself is largely a product of its internal solvation. An attempt is made to correlate results with proposed models including osmotic pressure approach, electrostatic approach, and entropy model. (DHM)

17025 RECENT DEVELOPMENT IN SOLVENT EXTRACTION. De, A. K. pp 206-22 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

Recent developments in solvent extraction are reviewed including synergism, substoicheiometric extraction, substoicheiometric determination in activation analysis, liquid ion exchangers, reversed-phase partition chromatography, combined ion exchange-solvent extraction, and ternary complexes. (DHM)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 17117.

Chemical and Physicochemical Properties

Refer also to abstracts 17172, 17754, 17804, 17805, 17809, 17843, 17857, and 19010.

17026 (SLA-73-53(Vol. 1)) FUSED SALTS, A BIBLIOGRAPHY. VOLUME I. Citations listing. Schalit, Michael (comp.) (Sandia Labs., Livermore, Calif.). Dec 1972. 617p. Dep. NTIS.

17027 (SLA-73-53(Vol. 2)) FUSED SALTS, A BIBLIOGRAPHY. VOLUME II. Symbols and formulae index. Schalit, Michael (comp.) (Sandia Labs., Livermore, Calif.). Dec 1972. 306p. Dep. NTIS.

17028 (SLA-73-53(Vol. 3)) FUSED SALTS, A BIBLIOGRAPHY. VOLUME III. Descriptive terms index. Schalit, Michael (comp.) (Sandia Labs., Livermore, Calif.). Dec 1972. 353p. Dep. NTIS.

17029 (SLA-73-53(Vol. 4)) FUSED SALTS, A BIBLIOGRAPHY. VOLUME IV. Authors index. Schalit, Michael (comp.) (Sandia Labs., Livermore, Calif.). Dec 1972. 268p. Dep. NTIS.

17030 CHEMISORPTION AND CATALYSIS OF HYDROGEN ON POLYCRYSTALLINE WIRES OF TUNGSTEN AND NICKEL. Batt, A.M.; Eley, D.D.; Norton, P.R. (Univ. of Nottingham, Eng.). Proc. Roy. Soc. (London), Ser. A; 331: No. 1586, 377-381(29 Dec 1972).

The heat of absorption of hydrogen (and deuterium) as a function of coverage for a metal surface is correlated with the kinetics of the hydrogen–deuterium reaction studied over a wide range of pressures and temperatures, in order to throw further light on reaction mechanism. The metals are studied as polycrystalline wires cleaned by a process of successive treatments with oxygen and hydrogen to remove carbon, followed by flashing to an appropriate high temperature in an apparatus which may be pumped to 10^{-8} Pa. Tungsten and nickel were studied, the first being body-centered cubic and the second face-centred cubic. To estimate the number of metal atoms or sites equal areas of the two lowest energy planes are assumed as follows: W, b.c.c. (110),(100) 12.15×10^{18} sites m^{-2}; Ni, f.c.c. (111), (100) 17.5×18^{18} sites m^{-2}. The most frequent nearest neighbour spacings are W-W = 0.315 nm and Ni-Ni = 0.248 nm. (auth)

17031 APPROXIMATE EQUATION OF STATE FOR SUPERHEATED HEAVY WATER VAPOUR. Ivey, C. M.; Tarasuk, J. D. (Univ. of Western Ontario, London). Mech. Chem. Eng. Trans.; MC8: No. 1, 66(May 1972).

An existing general equation of state for an imperfect polyatomic gas was fitted to the critical point data for heavy water. A comparison with available experimental data indicated an average deviation of 2.0% for pressure values over the range considered. This equation may be useful in obtaining approximate values for pressure particularly near the critical point. (auth)

17032 IGNITION OF SODIUM METAL, SODIUM PEROXIDE MIXTURES. Newman, R. N.; Smith, C. A. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 117-119(Jan 1973).

Mixtures of sodium metal and commercial sodium peroxide were ignited both in air and in inert atmospheres. The burning rate and spectra from the flash were recorded. The experimental details are briefly outlined and the results shown graphically. It is seen that ignition took place as the sodium melted and flowed into the peroxide. The basis of the process and the subsequent chain of events is discussed. (UK)

Isotope Effects

Refer also to abstracts 17104, 17109, and 17803.

17033 S-ACYLCYSTEINE PEPTIDES. Synthesis and Kinetics of Hydrolysis. Clark, D. G.; Cordes, E. H. (Indiana Univ., Bloomington). J. Org. Chem.; 38: No. 2, 270-277(26 Jan 1973).

A series of S-acylcysteines, seryl-S-acylcysteines, and S-acylcysteinylthreonines was synthesized and characterized. Both N,S-diacetylcysteinamide and N-acetyl-S-benzolycysteinamide are more reactive toward hydroxide ion than expected on the basis of the reactivity of simpler thiol esters: second-order rate constants for alkaline hydrolysis in water at 39°C are 390 M^{-1} min^{-1} and 154 M^{-1} min^{-1}, respectively. N-Cbz-S-acetyl-L-cysteinyl-L-threonine ethyl ester was found to be 5–6 times more reactive than N,S-diacetylcysteinamide; k_2 for reaction with hydroxide ion at 39°C is 2300 M^{-1} min^{-1}. NoS → O acyl transfer reaction was detectable during the hydrolysis of this S-acetyldipeptide. The magnitude of the solvent deuterium isotope effect for hydrolysis of this substrate, $k_{H_2O}/k_{D_2O} = 2.7$, suggests that the enhanced reactivity may reflect general acid-base catalysis involving the threonyl hydroxyl function. Imidazole catalyzes the hydrolysis of both N,S-diacetylcysteinamide and N-Cbz-S-acetyl-L-cysteinyl-L-threonine ethyl ester by a general base mechanism; these two substrates are about equally reactive toward imidazole. N-Cbz-L-serinyl-S-benzoyl-L-cysteine methyl ester has a second-order rate constant for alkaline hydrolysis in 40% dioxane at 39° of 480 M^{-1} min^{-1}, some 40 times greater than that for N-acetyl-S-benzoylcysteinamide under the same conditions. Implications of these results for understanding the reactivity of S-acylated glyceraldehyde-3-phosphate dehydrogenases are discussed. (auth)

17034 ANOMALOUS HYDROGEN EXCHANGE REACTIONS IN HSO_3F-SbF_5. Kramer, G. M.; Pancirov, R. J. (Esso Research and Engineering Co., Linden, NJ). J. Org. Chem.; 38: No. 2, 349-353(26 Jan 1973).

Olefins, when added to SbF_5-HSO_3F solutions in the presence of alkylcycloalkanes or alkanes, are converted into the corresponding paraffin. However, labeling studies using tritiated acid and methylcyclohexane-d_{14} show that significant amounts of product do not arise via a normal carbonium ion path, which would have introduced one proton from the acid and one from the hydride donor into the products. Instead, much of the product appears to form by a process in which the alkylcycloalkane transfers two hydrogen atoms to the olefin. The possibility of a chain reaction at the acid–hydrocarbon interface or the intervention of radical cations leading to these results is considered. (auth)

17035 RELATIONSHIP OF CATALYTIC ACTIVITIES OF NICKEL–COPPER ALLOYS TO RECENT DETERMINATIONS OF THEIR ELECTRONIC STRUCTURE. Spooner, T. A.; Clarke, J. K. A. (University Coll., Dublin). Ber. Bunsenges. Phys. Chem.; 76: No. 11, 1187-1190(Nov 1972).

Homogeneous Ni–Cu alloy films formed in ultrahigh vacuum show persistence of activity for the ethane–deuterium exchange reaction at 300 to 380°C to low Ni content (4%), although activity is reduced compared to 100% Ni; Cu films are inactive at 450° or lower. This form of pattern confirms those reported previously for C–H and H–H bond activation on films prepared in conventional vacuum. Results now available on the (bulk) electronic characteristics of Ni–Cu solutions make possible a unified interpretation (basically through the "individual atom" approach) for these patterns. Attention is drawn to such additional influences as nearest-neighbour interaction within the alloy and, at low Ni contents, diminished mobility of d-vacancies. (auth)

17036 ONE-ELECTRON VS. TWO-ELECTRON OXIDATIONS. THE VANADIUM(V) AND MANGANESE(III) OXIDATIONS OF CYCLOBUTANOL. Rocek, J.; Radkowsky, A. E. (Catholic Univ. of America, Washington, DC). J. Org. Chem.; 38: No. 1, 89-95 (12 Jan 1973).

Vanadium(V) oxidizes cyclobutanol in high yields to the ring cleavage product, γ-hydroxybutyraldehyde. The observations that 1-methylcyclobutanol reacts about nine times faster than cyclobutanol, that the oxidation of 1-deuteriocyclobutanol is accompanied by a low deuterium isotope effect ($k_H/k_D = 1.21$), and that cyclobutanol is about 1000 times more reactive than cyclohexanol, all support the mechanism consisting of a rate-limiting ring opening reaction leading to the $\cdot CH_2CH_2CH_2CHO$ radical as the first reaction product. The presence of manganese(II) in chromic acid oxidations of cyclobutanol has a strong accelerating effect on the reaction, and leads to a large decrease in the deuterium isotope effect and to a large increase in the reactivity of 1-methylcyclobutanol. The yield of cyclobutanone decreases and that of hydroxybutyraldehyde increases with increasing concentration of manganese(II) in the system. These observations are consistent with a mechanism in which the effective oxidant is manganese(III), formed probably by the reaction $Cr(VI) + Mn(II) \rightleftharpoons Cr(V) + Mn(III)$, reacting via the same free radical intermediate as vanadium(V). Both results strongly indicate that cyclobutanol reacts rapidly and smoothly with one-electron oxidizing agents under ring cleavage, and can be successfully employed as a probe for one-electron oxidants. (auth)

17037 THERMAL REACTION OF ALKYL N-CARBOMETHOXYSULFAMATE ESTERS. Burgess, E. M.; Penton, H. R. Jr.; Taylor, E. A. (Georgia Inst. of Tech., Atlanta). J. Org. Chem.; 38: No. 1, 26-31(12 Jan 1973).

(Carboxysulfamoyl)triethylammonium hydroxide, inner salt, methyl ester was synthesized and shown to react with a broad spectrum of alcohols resulting in alkyl N-carbomethoxysulfamate esters. The scope and synthetic usefulness of the sulfamate ester function as a leaving group in thermolytic dehydration reactions was demonstrated by the facile conversion of tertiary and secondary alcohols to olefins and primary alcohols to urethanes. Stereochemically the reaction was established as a cis-stereospecific elimination by the formation of only protio-trans-stilbene from threo-2-deuterio-1,2-diphenylethyl-N-carbomethoxysulfamate triethylammonium salt and only α-deuterio-trans-stilbene from the corresponding erythro compound. The first-order rate constants for the diphenylethanol system were determined spectrophotometrically ($k_{35°} = 2.66 \times 10^{-6}$) and a small β-deuterium isotope effect was observed ($k_H/k_D = 1.05$ for erythro and 1.08 for threo compound). Activation parameters were calculated for

the thermolysis with values E_a = 22.4 kcal/mol, $\Delta H^{\ddagger}$ = 21.7 kcal/mol, $\Delta G^{\ddagger}$ = 22.8 kcal/mol, $\Delta S^{\ddagger}$ = −3.3 eu. These kinetic and stereochemical results are consistent with an initial rate-limiting formation of an ion pair followed by a fast cis β proton transfer to the departing anion at a rate greater than the interconversion of erythro- and threo ion pairs. (auth)

17038 SPECTRA AND STRUCTURE OF ORGANOGERMANES. XV. Microwave Spectrum of Trimethylgermane. Durig, J. R. (Univ. of South Carolina, Columbia); Chen, M. M.; Li, Y. S.; Turner, J. B. J. Phys. Chem.; 77: No. 2, 227-229(18 Jan 1973).

The rotational spectrum of trimethylgermane was recorded from 18.0 to 40.0 GHz. The ground-state rotational constants were determined for ten different isotopic species. A r_s value of 1.532 ± 0.001 Å was determined for the GeH bond distance. With this value of the GeH distance and an assumed structure for the methyl group, the following two structural parameters were obtained: r(GeC) = 1.947 ± 0.006 Å and ∠CGeH = 109.3 ± 0.1°. The determined structural parameters are compared to the corresponding ones for other methyl-substituted germanes. (auth)

17039 MATHEMATICAL TREATMENT OF ENZYME-CATALYZED ISOTOPE EXCHANGE REACTIONS. Flossdorf, J.; Kula, M. R. Gesellschaft fuer Molekularbiologische Forschung mbH, Stoeckheim, Ger.). Eur. J. Biochem.; 30: No. 2, 325-9 (1972).

A simple method of treating the kinetics of enzyme-catalyzed isotope exchange reactions in systems at equilibrium is given. It depends on the analogy between the transfer of a label between species in a reacting chemical system and the flow of charge between capacitors in an electrical circuit. (Germany)

17040 HYDROLYSIS OF ORGANIC PHOSPHATES. PART VII. HYDROLYSIS OF DIALLYL ORTHOPHOSPHATE (SODIUM SALT). Mhala, M.M.; Saxena, S.B. (Madhav Engineering Coll., Gwalior, India). Indian J. Chem.; 10: No. 7, 703-705(Jul 1972).

Hydrolysis of diallyl orthophosphate (sodium salt) was studied in perchloric acid and buffer solutions at 80°. Conjugate acid and neutral species are the reactive species. In moderately strong acid solutions a relationship between Hammett acidity function $-H_0$, and the reaction rates is observed indicating specific acid-catalysed unimolecular hydrolysis. In pH region 0 to 4 neutral species are reactive. Mononegative species are found to be inert. Theoretical rates in the region of neutral species agree well with experimentally observed reaction rates. Temperature, solvent, and solvent isotope effects were studied. (auth)

17041 HYDROGEN–DEUTERIUM ISOTOPE EFFECTS FOR THE BASE PROMOTED E2 REACTION OF QUATERNARY AMMONIUM IONS. THE EFFECT OF BASE, SOLVENT, AND STRUCTURE ON THE NATURE OF THE TRANSITION STATE. Smith, P. J.; Tsui, S. K. (Saskatchewan Univ., Saskatoon, Canada). Tetrahedron Lett.; No. 1, 61-64(Jan 1973).

The hydrogen–deuterium isotope effects as well as the Hammett rho were determined for reaction of 1-arylethyltrimethylammonium ions with t-butoxide in t-butanol at 30°C and ethoxide ion in EtOH–DMSO mixtures at 70°C. The results are presented, together with the results obtained previously for reaction with ethoxide ion. The effect of a structural change on the nature of the transition state was investigated by studying the reaction of 2-substituted 9-methylfluorene-9-trimethylammonium ions with ethoxide at 40°C and the results are presented. (auth)

17042 ACID–BASE EQUILIBRIA OF NITROPYRIDINES IN PROTIUM OXIDE AND IN DEUTERIUM OXIDE. Bellobono, I.R.; Diani, E. (Univ., Rome). J. Chem. Soc., Perkin Trans., II; No. 12, 1707-1708(1972).

Equilibrium constants for the dislocation of 2-, 3-, and 4-NO_2-$C_5H_4NH^+$ in H_2O were measured as a function of temperature in the range 3 to 70°C by spectrophotometric determination of acid-base concentration ratios in aqueous solution of constant ionic strength (0.02 M) or in aqueous sulphuric acid. Thermodynamic functions ($\Delta G°$, ΔH, and $\Delta S°$) were calculated for these equilibria as well-behaved functions of temperature and compared with those relative to acid-base equilibrium of unsubstituted pyridine. Entropy values for the above reactions are nearly equal, so that the free-energy differences, due to the different acidities, are mainly found as differences between the corresponding enthalpies. Equilibrium constants for the dissociation of 2-, 3-, and 4-$NO_2C_5H_4ND^+$ in D_2O were also measured at 298.2°K. Isotope effects seem to be mainly determined by solvation characteristics of the system. (auth)

17043 ABSOLUTE STEREOCHEMISTRY OF ISOTOPIC EXCHANGE AND METHYLATION IN BENZYL METHYL SULPHOXIDE. Nishihata, K.; Nishio, M. (Meiji Seika Kaisha Ltd., Yokohama, Japan). J. Chem. Soc., Perkin Trans., II; No. 12, 1730–1732(1972).

α-Sulphinyl carbanions generated from diasteromeric monodeuteriobenzyl methyl sulphoxides were quenched with water and methyl iodide and the kinetic isotope effect also determined. Analyses of the isomer distributions and the deuterium content of the resulting mixture revealed that the stereochemical pathway of these reactions consists of three distinct steps, namely (i) the stereochemistry of the formation of carbanions, (ii) the stereochemistry of the configurational inversion equilibrium, and (iii) the stereochemistry of the approach of the electrophile. It was concluded that the pro-R hydrogen in the (S)-sulphoxide is abstracted preferentially, k(R)/k(S) ca. 1.5, and that the equilibrium constant between the configurationally inverted carbonions is ca. 20 in favour of the carbanion having the carbon lone pair which bisects the sulphur lone pair and the S–O bond. It is also suggested that the isotopic exchange occurs with retention and the methylation with inversion during the final substitution step in the light of Wolfe's theoretical requirement from extensive non-empirical calculations on α-sulphinyl carbanions. (auth)

17044 SEPARATION OF DEUTERIATED POLAR COMPOUNDS ON CAPILLARY COLUMNS. Le-Chil-Le; Sakodynskii, K. (Moscow Physical-Chemical Inst.). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 6, 864-868(Jun 1972).

Translated from Zh. Fiz. Khim.; 46: No. 6, 1510-1514(Jun 1972).

The separation of mixtures of normal and deuteriated C_1–C_3 alcohols and pyridines was achieved on capillary gaschromatographic columns equivalent to 50,000 to 100,000 theoretical plates. The separation factors for binary mixtures were determined and the enthalpy and entropy differences in partition on polar [poly (ethylene glycol) and poly(propylene glycol)] and non-polar (siloxane rubber) were calculated. Both direct and isotope effects were observed. (auth)

17045 ISOTOPE AND BONDING EFFECTS IN AMMONIUM OXALATE MONOHYDRATE, DETERMINED BY THE COMBINED USE OF NEUTRON AND X-RAY DIFFRACTION ANALYSES. Taylor, J. C.; Sabine, T. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Acta Crystallogr., Sect. B; 28: No. 11, 3340-3351(1972).

Three-dimensional neutron and x-ray diffraction structural analyses were carried out on protonated, deuterated, and null-matrix (63% H, 37% D) crystals of ammonium oxalate monohydrate. The null-matrix composition is such that the neutron hydrogen and deuterium scattering lengths cancel ($b_H = -0.378 \times 10^{-12}$ cm; $b_D = 0.65 \times 10^{-12}$ cm). Absorption and extinction corrections were applied and refinement was by full-matrix least-squares calculations with anisotropic temperature factors. It was found statistically that different sets of coordinates and temperature factors resulted if extinction corrections were not applied. In the null-matrix crystal the deuterium atoms show a preference for the ammonium ion sites and the protons for the water sites, with a separation factor (H/D) water/(H/D) ammonium of 1.07 (2). There was no significant expansion of the hydrogen bonds on deuteration. X–N maps for the deuterated and protonated forms (difference syntheses derived from neutron parameters and x-ray data) revealed deviations from spherical symmetry of the atoms, consistent with bonding and lone-pair electron distributions. These features were not observed with the x-ray data for the null-matrix crystals because of excessive extinction and would not have been seen for the deuterated and protonated crystals had extinction corrections not been applied. (auth)

17046 INFRARED SPECTRA OF HCN ISOTOPES IN ARGON MATRICES. AN EXAMINATION OF THE ASSUMPTIONS OF MATRIX ISOLATION SPECTROSCOPY. Pacansky, Jacob; Calder, G. V. (Ames Lab., IA). J. Mol. Struct.; 14: No. 3, 363-83(Dec 1972).

The infrared spectra of HCN isotopes in argon matrices are interpreted. Discrepancies of ~2 cm^{-1} between the isotope shifts in the matrix and gaseous spectra were observed, and the origin of the discrepancies is examined in detail. The analysis shows that the discrepancies cannot be attributed to experimental error, changes in the anharmonic character, or a change in the geometry of HCN in the matrix; but are caused by the limitation of the linear XYZ vibrational model as a description of the motions of the matrix isolated HCN molecule. (auth)

17047 PROPERTY OF THE FORCE CONSTANT MATRICES SATISFYING THE VIBRATIONAL EQUATIONS OF TWO ISOTOPIC SPECIES. Jordanov, B. (Inst. of Organic Chemistry, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 8, 1073-1076(1972).

It is shown that only one F matrix can reproduce simultaneously the frequencies of two isotopic species for the assumed permutation of the diagonal matrices of the positive eigenvalues of the matrix products. Therefore, N! solutions may be expected to be found, which reproduce the vibrational equations of two isotopic species. (MCG)

17048 BINARY TRANSITION METAL DINITROGEN COMPLEXES. I. MATRIX INFRARED AND RAMAN SPECTRA, STRUCTURE, AND BONDING OF $Ni(N_2)_n$ AND $Pd(N_2)_m$(n = 1 TO 4 AND m = 1 TO 3). Huber, H.; Kuendig, E. P.; Moskovits, M.; Ozin, G. A. (Univ. of Toronto). J. Amer. Chem. Soc.; 95: No. 2, 332-344(24 Jan 1973).

The products of the cocondensation reactions of Ni and Pd atoms with N_2 at 4.2 to 10°K are investigated by matrix isolation infrared and Raman spectroscopy and are shown to be binary dinitrogen complexes of the form $Ni(N_2)_n$ and $Pd(N_2)_m$. Examination of the reaction products in pure $^{14}N_2$, in $^{14}N_2/^{15}N_2$, and in dilute $Ar/^{14}N_2$, $Ar/^{14}N_2/^{15}N_2$, and $Ar/^{14}N^{15}N$ matrices establishes the stoichiometries of the complexes to be respectively n = 1 to 4 and m = 1 to 3. Structural assignments can be made for most of the complexes on the basis of infrared and Raman activities and are found to be similar to the analogous carbonyls. Isotopic frequencies and integrated infrared absorption intensities, computed for the NN stretching modes of the individual dinitrogen complexes on the basis of the Cotton–Kraihanzel force field approximation and on isotopic intensity sum rules, are found to be in close agreement with the agreement with the observed values. $Ni(N_2)_4$ in argon is a regular tetrahedral molecule with "end on bonded" dinitrogen. In nitrogen, however, it is slightly distorted. Calculations show that a substitutional site symmetry of C_2 for $Ni(N_2)_4$ satisfactorily accounts for all of the spectral lines observed for the complex in nitrogen. (auth)

17049 BASE-CATALYZED HYDROLYSIS OF N-ACYLPYRROLES. A MEASURABLE ACIDITY OF A STEADY-STATE TETRAHEDRAL INTERMEDIATE. Menger, F. M.; Donohue, J. A. (Emory Univ., Atlanta). J. Amer. Chem. Soc.; 95: No. 2, 432-437(24 Jan 1973).

The basic hydrolysis of N-acetylpyrrole is second order in hydroxide ion at low base concentrations while first order in hydroxide ion at high base concentrations. There is an inverse solvent isotope effect and no general base catalysis. On the other hand, the hydrolysis of N-p-nitrobenzoylpyrrole is first-order in hydroxide ion and is subject to general base catalysis. The mechanisms of the two hydrolyses (involving a change in the rate-determining step in the acetyl system) and the source of their differences are analyzed in detail. A unique sigmoid pH-rate profile for N-salicylylpyrrole is described. Its flex point lies 1.4 pH units above the pK_a of the substrate. Moreover, the rate is independent of the pH for all pH values above 11. These results are interpreted in terms of a kinetically important ionization of a steady-state intermediate, the first example of its kind. Both formation and collapse of the intermediate involve intramolecular participation. (auth)

17050 ELIMINATION OF WATER FROM HEXANOL AT 10^{-11} TO 10^{-5} SECOND FOLLOWING FIELD IONIZATION. Derrick, P. J.; Falick, A. M.; Burlingame, A. L. (Univ. of California, Berkeley). J. Amer. Chem. Soc.; 95: No. 2, 437-443(24 Jan 1973).

The elimination of water from hexanol following field ionization (FI) was studied at times from 10^{-11} to 10^{-5} sec. Investigation of the deuterated species hexanol-3,3-d_2 and hexanol-4,4-d_2 firmly establishes that the elimination of water involves hydrogen from C-3 as well as from C-4. Phenomenological rate constants k(t) were calculated as functions of time from 10^{-11} to 10^{-5} sec for the process involving transfer of hydrogen from C-3 via a five-membered cyclic transition state and for that involving transfer from C-4 via a six-membered cyclic transition state. Comparison of the kinetics of the two processes suggests that the six-membered transition state is thermodynamically favored over the five membered; for the most energetic ions (produced by FI), however, the reactions via the two transition states occur with equal probability. It is opined that the frequency factors for the five- and six-membered transition states are both of the same order of magnitude (10^{10} sec^{-1}). Hydrogen–deuterium randomization is unimportant at times less than 10^{-9} sec following FI and probably at longer times as well. It is suggested that the conclusions of the electron impact studies on hexanol have overestimated the importance of transfer of hydrogen from C-4 in the loss of water. (auth)

17051 PHOTODISSOCIATION OF TOLUENE PARENT CATIONS. Dunbar, R. C. (Case Western Reserve Univ., Cleveland). J. Amer. Chem. Soc.; 95: No. 2, 472-476(24 Jan 1973).

Ion cyclotron resonance photodissociation techniques were used to investigate the events following photoexcitation of toluene parent cations. Photodissociation to produce $C_7H_7^+$ proceeded readily. The threshold behavior was discussed both in terms of the thermochemistry of the reaction and the optical absorption properties of the cation, and it appeared that both influences were likely to be involved. Examination of deuterated toluenes showed that photodissociation occurred with complete hydrogen scrambling and a strong isotope effect. The energy dependence of the isotope effect was studied in detail and was found to agree with that determined for dissociative electron-impact ionization, and also with quasi-equilibrium theory calculations. Determination of the C–D bond dissociation energy by extrapolation to infinite isotope effect gave close agreement with the best available thermochemical data. The photoproduced $C_7H_7^+$ cations reacted with parent neutrals to give $C_8H_9^+$. The dependence of the reaction rate on photon energy was determined and suggested the presence of an activation energy for the reaction. (auth)

17052 CYCLOPROPANOLS. X. OXIDATION OF CYCLOPROPANOLS BY PHOTOEXCITED ARYL KETONES. DePuy, C. H.; Jones, H. L.; Moore, W. M. (Univ. of Colorado, Boulder). J. Amer. Chem. Soc.; 95: No. 2, 477-481(24 Jan 1973).

Cyclopropanols undergo facile reactions with photoexcited aryl ketones such as benzophenone. These are oxidation–reduction processes involving the transfer of the hydroxyl hydrogen atom from the cyclopropanol to the ketone. From studies of the quantum yields it is concluded cyclopropanols react with high efficiency and are equivalent to such reactive substrates as benzhydrol in these photochemical oxidation–reductions. Several ketones, such as fluorenone, which are normally unreactive toward hydrogen atom abstraction do react readily with cyclopropanols. Isotope effect values are given for benzophenone–1,2,3-trimethylcyclopropanol. (auth)

17053 NUCLEAR MAGNETIC RESONANCE STUDIES OF THE MECHANISM OF KETO–ENOL TAUTOMERISM IN 3-HYDROXY-2,4-DIMETHYLCYCLOBUTENONE. II. SOLVENT AND pH EFFECTS. Chickos, J. S.; Winter, R. E. K. (Univ. of Missouri, St. Louis). J. Amer. Chem. Soc.; 95: No. 2, 506-511(24 Jan 1973).

An NMR method is applied to a study of prototropic shifts in a highly enolized system. The temperature-dependent NMR spectrum of 3-hydroxy-2,4-dimethylcyclobutenone (1) was examined as a function of pH, and the NMR rates obtained were analyzed according to the general acid–base catalysis scheme. In the low pH limit investigated (pH ~ 0), the NMR rates are insensitive to the concentration of 1. At higher pH, the rates become concentration dependent. Rates were found dependent on the water concentration. The pH–rate profile is explained on the basis of two competing reactions, both involving the enolate ion of 1 and proceeding by way of 2,4-dimethyl-1,3-cyclobutanedione. Activation parameters, E_a of 13.6 and 13.2 kcal/mol and ln A of 28.9 and 24.7 sec^{-1}, were calculated at pH 1.6 and 2.8, respectively, and a solvent deuterium isotope effect, k_{H_2O}/k_{D_2O}, of 5.0 ± 1.0 and 3.0 ± 1.0 was observed. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 17105.

17054 ISOTOPIC EQUILIBRIUM IN THE HYDROGEN-PALLADIUM SYSTEM. Domanov, M. M.; Andreev, B. M. (Moscow Inst. of Chemical Tech.). Russ, J. Phys. Chem. (Engl. Transl.); 46: No. 6, 906-907(Jun 1972).

Translated from Zh. Fiz. Khim.; 46: No. 6, 1583(Jun 1972).

Isotopic equilibrium in the hydrogen–palladium system was investigated at 77°K by spectral analysis. A separation factor of 3.5 is found, opposite in sign to that usually observed in this system, its value being governed by surface sorption effects. (auth)

17055 SEPARATION OF URANIUM ISOTOPES BY ION EXCHANGE. Part I. Behaviour of ^{234}Th and ^{234}Pa During the Uranium Band Displacement on Cation Exchange Resin by Acetate and Citrate Eluents. Calusaru, A.; Bunus, F. (Inst. of Atomic Physics, Bucharest). Radiochim. Acta; 18: No. 1, 23-30(Dec 1972).

During the uranium band displacement on cation resin the behaviour of the radioactive fraction depends on the eluent composition: (1) in the case of acetate eluent the radioactivity remains at the top of the column and is separated from uranium; (2) in the case of citrate eluent the uranium descendents are displaced together with the uranium band, but are concentrated at the head of the band. In the radioactive fraction the identification of ^{234}Th was made by gamma spectroscopy, determining the characteristic energy peaks at 69 and 97 keV and the corresponding half-life, 24.1 days. The maximum energy of beta particles was determined by the absorption in calibrated aluminium foils. The finded value of 2.1 MeV corresponds to ^{234m}Pa (1.18 min). The explanation of the ^{234}Th and ^{234}Pa behavior during uranium band displacement with acetate and citrate eluents is founded on the study of the distribution constants for uranium, thorium, and protactinium. In citrate medium a similitude of the distribution constant variation versus p_H was found, while in acetate medium the same variation for the three mentioned elements is different. The role of the

hydrolysis phenomena during the distribution constant measurements was emphasized. (auth)

17056 SPIROAROMATICITY IN SPIRO[2.3]HEXADIENYL ANIONS. KINETIC ACIDITIES IN HIGHLY BASIC MEDIA. Semmelhack, M. F.; DeFranco, R. J.; Margolin, Z.; Stock, J. (Cornell Univ., Ithaca, NY). J. Amer. Chem. Soc.; 95: No. 2, 426-432(24 Jan 1973).

Experimental tests for special stabilization (spiroaromaticity) in a spiro[2.3]hexadienyl anion compared with a series of spiro [2.3]hex-4-en-6-yl anions using polarography and kinetic acidity measurements reveal no significant stabilization. The kinetic acidity data were obtained by hydroxide ion catalyzed tritium exchange in dimethyl sulfoxide–water mixtures. (auth)

Feed Materials Processing

Refer also to abstract 17129.

17057 (HMI-B-116) INTRODUCTION INTO NUCLEAR CHEMICAL ENGINEERING, PART I. Levi, H. W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Feb 1972. 218p. (In German). Dep. NTIS (U. S. Sales Only).

The text originates from lectures given during 1969/70 at MIT, Cambridge, Massachuetts and in subsequent years at the Technical University at Berlin, Germany. The content addresses students of nuclear engineering as well as chemistry. Treated are basic nuclear chemistry, management of in-core fuel material, mining and processing of uranium, the basics of ion exchanges, and uranium enrichment. (HBG)

17058 ISOTOPIC ANOMALIES IN U FROM GABON. Bodu, R. (CEN, Fontenay-aux-Roses, France); Bouzigues, H.; Morin, N.; Pfiffelmann, J.-P. Compt. Rend., Ser. D; 275: No. 16, 1731-1732(16 Oct 1972). (In French).

The control of UF_6 production revealed the presence of significant isotopic anomalies in U ores from the Oklo deposit (Gabon). The results of the analyses performed are given and the deposit is briefly discussed. (France).

17059 PRESSURE HYDROMETALLURGY. A BIBLIOGRAPHICAL REVIEW. Derry, R. Mineral Processing Information Note, No. 7. Stevenage, Eng.; Warren Spring Laboratory (1972). 125p.

After considering the general thermodynamic, kinetic, and solubility data relevant to carrying out reactions at elevated temperatures, the application of pressure techniques to the extraction of specific metals from ores, concentrates and secondary materials is described. The review covers both existing commercial processes and processes which have been proposed in the literature. Information on process economics is included where the data are available, and some aspects of the design of equipment are discussed. (auth)

Radiation Chemistry

Refer also to abstracts 17509–17511, 17519, 17692, 17916, and 18992.

17060 (NP-19624) CHEMISTRY AROUND RESEARCH REACTORS, PAEC-CENTRO STUDY INSTITUTE, LAHORE, PAKISTAN, OCTOBER 12–24, 1970. (Atomic Energy Centre, Lahore (Pakistan)). 1970. 207p. Dep. NTIS (U. S. Sales Only).

In an effort to help developing countries to develop a chemistry program around a research reactor, a study institute was held at Atomic Energy Centre, Lahore. Topics discussed include nuclear reactors, physics and chemistry of fission, plutonium chemistry, radiation protection techniques, γ spectroscopy, activation analysis, radiochemical separations, isotope production, and radiation chemistry. (DHM)

17061 (ORO-4183-15) CHEMICAL EFFECTS OF IONIZING RADIATIONS ON THE INDIVIDUAL AMINO ACIDS WITHIN INTACT AND PURE PROTEIN MOLECULES. Comprehensive report. Friedberg, Felix (Howard Univ., Washington, D. C. Dept. of Biochemistry). 1972. Contract AT(40-1)-4183. 5p. Dep. NTIS.

17062 CHEMICAL SCREENING TESTS FOR CELLULAR RADIOSENSITIZERS: NITROFURANS. Greenstock, C. L.; Raleigh, J. A.; Kremers, W.; McDonald, E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Int. J. Radiat. Biol.; 22: No. 4, 401-5(Oct 1972).

Results are presented of two chemical screening tests used to study the radiosensitizing effect of solutions of nitrofurans. In the first, the effect was measured in terms of base damage in deoxgenated 10^{-2} M thymine solutions, irradiated in the presence of 2×10^{-4} M nitrofuraldehyde diacetate and nitrofurazone. The damage was measured spectrophotometrically as a loss of absorption at 264 nm over a dose range 0 to 900 krads, using ^{60}Co γ-rays. In the case of the nitrofuraldehyde diacetate, the G value for base destruction was increased from 0.7 to 1.4, and for nitrofurazone from 0.7 to 1.6, measured in deoxygenated conditions in each case. In the second test, the radiosensitization was measured in terms of inorganic phosphate release in deoxygenated 10^{-2} M solutions of (a) o-phosphorylethanolamine (OPEA) and (b) deoxyuridine-5-monophosphate (5'-dUMP) in the presence of 10^{-4} M nitrofuran solutions. In this case, the G value (±5%) under nitrogen measured at a dose of 180 Krads increased from 0.80 in the absence of drugs to 1.25 and 1.30 for 10^{-4} M nitrofuraldehyde diacetate and nitrofurazone respectively. At a dose of 180 Krads and a 10^{-2} M concentration of 5'-dUMP, the G value under nitrogen increased from 0.13 in the absence of drugs to 0.18. The G value was unchanged in oxygenated solutions. (UK)

17063 FREE RADICAL SCAVENGING AT HIGH DOSE RATES IN THE RADIOLYSIS OF LIQUID CARBON TETRACHLORIDE. Bibler, N. E. (E. I. du Pont de Nemours and Co., Aiken, SC). Contract AT(07-2)-1. J. Phys. Chem.; 77: No. 2, 167-170 (18 Jan 1973).

The kinetics of radical scavenging at dose rates of $\sim 10^{25}$ eV/(g sec) were investigated by pulse radiolysis of samples of liquid carbon tetrachloride containing varying concentrations of Br_2. At Br_2 concentrations greater than 0.045 M, the 100-eV yields of radiolytic products were equal to published values determined at dose rates $\sim 10^9$ times lower. As the Br_2 concentration decreased below 0.04 M in the pulse radiolysis experiments, $G(C_2Cl_6)$ increased, $G(CCl_2Br_2)$ and $G(CCl_3Br)$ decreased, and $G(C_2Cl_4)$ remained unchanged. These results are consistent with the free radical mechanism developed at low dose rates after the inclusion of recombination reactions involving CCl_3 and Cl radicals. Quantitative agreement for the effect of scavenger concentration on $G(CCl_3Br)$ and $G(C_2Cl_6)$ was attained between observed results and those calculated by numerical integration of rate equations derived from the free radical mechanism assuming a homogeneous distribution of intermediates. (auth)

17064 ELECTRONIC PROCESSES IN PULSE-IRRADIATED AQUEOUS AND ALCOHOLIC SYSTEMS. Fisher, M. M.; Hamill, W. H. (Univ. of Notre Dame, IN). (COO-38-855). J. Phys. Chem.; 77: No. 2, 171-177(18 Jan 1973).

The radiolytic yield of Cl_2^- in concentrated neutral aqueous NaCl was not diminished by 1 M Na_2SO_4, thereby removing the possible exclusive role of OH in the acid spur. This provides indirect support for the mechanism $H_2O^+ + Cl^- \rightarrow H_2O + Cl$ which must compete with $H_2O^+ + H_2O \rightarrow H_3O^+ + OH$, estimated to occur within $\sim 10^{-14}$ sec. Other anions undergo comparable reactions with H_2O^+. The combined yield of I_2^- and I_3^- in 1 M KI was decreased ~15% by 1 M $KC_2H_3O_2$ or 1 M $K_2C_2O_4$, while $k(C_2H_3O_2^- + OH)/k(I^- + OH) = 9.2 \times 10^{-3}$ and $k(C_2O_4^{2-} + OH)/k(I^- + OH) = 1.2 \times 10^{-3}$. In concentrated aqueous solutions of halide ions, pulse radiolysis appears to form appreciable yields of excited halide ions. In 1–2 M NaCl or 10 M LiCl, at pH ~6 and N_2 purged, the yield of Cl_2^- was constant for at least 50 nsec, but in N_2O-saturated solutions it increased by 20–40% within 60 nsec. The mechanism may be $Cl^{-*} + N_2O \rightarrow Cl + N_2O^-$. Acetone and Eu^{3+} produced similar enhancements of the yield of Cl_2^-. The effect of positive hole annihilation by anions on electron yields in ethanol was tested with 10 mM biphenyl, 10 mM pyrene, and 100 mM benzyl acetate. The yields of biphenyl and pyrene anions increased 18 and 25% by addition of 1 M $CaCl_2$, the yield of benzyl radical increased 25%. The increased yields of free electrons in alcohol and in water at high concentrations of anions is attributed to electron transfer from the anion to the dry hole (e.g., H_2O^+), thereby preventing electronic hole migration and its contribution to charge recombination. (auth)

17065 CONFIGURATION COORDINATE MODEL FOR THE HYDRATED ELECTRON. Tachiya, M.; Tabata, Y.; Oshima, K. (Tokyo Univ.). J. Phys. Chem.; 77: No. 2, 263-268(18 Jan 1973).

The configuration coordinate model is developed for the hydrated electron. The configuration coordinate diagram is constructed by calculating the total energies of the hydrated electron under various orientational polarizations. The absorption spectrum of the hydrated electron is calculated by use of this diagram. The calculated absorption maximum and half-width are 2.04 and 0.52 eV, respectively. They are in semiquantitative agreement with experiment. (auth)

17066 PROPOSED MECHANISM FOR THE TRANSIENT SUPPRESSION OF BACTERIAL LUMINESCENCE BY HYDROGEN PEROXIDE. Jacobson, A. P.; Papa, L. R.; Brendel, D. F. (Univ. of Michigan, Ann Arbor). J. Lumin.; 5: No. 6, 464-471(Dec 1972).

It has been shown previously that bacterial luminescence is reversibly suppressed in vivo and in vitro by both x-rays and hydrogen peroxide. Data are presented that show that the mechanism

for this phenomenon is based on the transient oxidation of reduced flavin mononucleotide. (auth)

17067 AUTORADIOLYSIS OF LABELED COMPOUNDS. Schweer, K. H. (Kernforschungszentrum, Karlsruhe, Ger.). pp 439-42 of Radioisotope in Pharmakokinetik und Klinischer Biochemie. /Hoffmann, G. (ed.). Stuttgart; Schattauer (1970). (In German).

Substances for which the storage and values of radiolysis have been described in the literature give other results in spite of equal treatment. Values of autoradiolysis of some compounds of one class of substances should only be transferred to new synthesized compounds of this class with caution after checking, because the degree of autoradiolysis can be seen as a property specific to the substance. (Germany)

17068 THERMOLUMINESCENCE AND THERMALLY STIMULATED CONDUCTIVITY IN POLYMERS. Ranicar, J. H.; Fleming, R. J. (Monash Univ., Clayton, Australia). J. Polym. Sci., Part A-2; 10: No. 10, 1979–1997(Oct 1972).

Thermoluminescence (TL) and thermally stimulated conductivity (TSC) glow curves in poly(vinyl chloride), polyethylene, polystyrene, polytetrafluoroethylene, and polyimide were compared, and many similarities observed. Comparison with available NMR, dynamic mechanical loss, and dielectric loss, molecular mobility data shows that most TL and TSC peaks occur at temperatures similar to those assigned to the onset of specific molecular motions, suggesting that the peaks are due to the liberation of electrons from traps formed by the polymer chains themselves, e.g., potential wells or cavities due to chain entanglement in amorphous regions, or main-chain branching points. Peaks for which correlation with molecular motion is not apparent are tentatively assigned to liberation of electrons from traps centered on impurities. The TSC peak temperatures in PVC were not affected in any consistent fashion by the application of high-strength electric fields during the warming process, indicating that the electron traps are electrically neutral when empty and charged when filled; the direction of the TSC currents appears to be determined by temperature gradients existing within the samples. The TL glow curves are generally in good agreement with the results of other workers. The dark dc conductivity of PVC not exposed to ionizing radiation rises sharply in the temperature region assigned to the β-relaxation process, suggesting that the electron mobility in that polymer is dominated by molecular chain motion, i.e., the interchain charge transport process is probably best described in terms of a hopping process. (auth)

17069 PULSE RADIOLYSIS OF ETHYL, N-PROPYL, N-BUTYL: AND N-AMYL AMINE IN AQUEOUS SOLUTIONS. Getoff, N.; Schwoerer, F. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr, Ger.). Int. J. Radiat. Phys. Chem.; 5: No. 1, 101-111(Jan 1973).

Pulse radiolysis of protonated and unprotonated ethyl (EA), n-propyl (n-PA), n-butyl (n-BA) and n-amyl amines (n-AA) has been carried out. For all unprotonated amines $k(e^-_{aq} + RNH_2) = (1.0 \pm 0.1) \times 10^6$ dm^3 mole^{-1} s^{-1} was found, whereas the corresponding k-values for the protonated amines were higher by a factor of 2.5 to 3. With increasing chain length of the amine molecule the $k(OH + RNH_3^+)$ values rise from 0.12×10^9 dm^3 mole^{-1} s^{-1} (for EA) to 6.2×10^9 dm^3 mole^{-1} s^{-1} (for n-AA). However, they are lower than the corresponding $k(OH + RNH_2)$ values (6.2×10^9 dm^3 mole^{-1} s^{-1} for EA and 9×10^9 dm^3 mole^{-1} s^{-1} for n-AA). A chain length dependence was also observed for $k(O^-_{aq} + RNH_2)$, starting with 8.65×10^9 dm^3 mole^{-1} s^{-1} (EA) and reaching 15.2×10^9 dm^3 mole^{-1} s^{-1} (n-AA). The absorption spectra of the transients produced by reaction of OH radicals with the two forms of the amines show significant differences. The short-lived protonated species give absorption maxima between 212.5 and 215 nm (ϵ_{max} = 96 to 108 m^2 mole^{-1}), while the corresponding data for the unprotonated transients are 222.5 to 225 nm (ϵ_{max} = 145 to 173 m^2 mole^{-1}). The rate constants for the second-order disappearance of the protonated species decrease gradually with an increase of the molecule chain length ($2k = 1.2 \times 10^9$ dm^3 mole^{-1} s^{-1} for EA to 0.4×10^9 dm^3 mole^{-1} s^{-1} for n-AA) and are lower than the values for the unprotonated transients ($2k = 1.7$ 10^9 dm^3 mole^{-1} s^{-1} for EA to 0.7×10^9 dm^3 mole^{-1} s^{-1} for n-AA). In accordance with previous observations it can be stated that OH radicals attack protonated amines mainly on the C-atoms farthest from the NH_3^+ group, while in the case of unprotonated amines the H abstraction occurs preferentially on N-atom and α-C positions. The results are of particular interest for radiation biology. (auth)

17070 PULSE RADIOLYSIS STUDY OF THE FORMATION OF TRANS-STILBENE IONS IN ORGANIC SOLVENTS. Kira, A.; Arai, S.; Imamura, M. (Inst. of Physical and Chemical Research, Wako, Japan). Int. J. Radiat. Phys. Chem.; 5: No. 1, 127-34 (Jan 1973).

Microsecond pulse radiolysis studies were carried out on trans-stilbene solutions in acetone, benzonitrile, dimethylsulphoxide, benzene, cyclohexane, acetonitrile, and dimethylformamide. The transient absorption spectra of the cation and anion of trans-stilbene appearing immediately after pulse irradiation are distinguished from each other by aeration or by addition of triethylamine. It was found that only the cation is produced in the benzonitrile solution; the anion is produced preferentially in the acetonitrile, dimethylformamide, and cyclohexene solutions; both the cation and anion are produced in the dimethylsulphoxide, benzene, and acetone solutions. (auth)

17071 RADIOLYSIS OF O_2-FREE AQUEOUS OXALIC ACID SOLUTIONS AT pH 1 TO 3. Markovic, V.; Sehested, K.; Bjergbakke, E. (Danish Atomic Energy Commission, Risoe). Int. J. Radiat. Phys. Chem.; 5: No. 1, 15-22(Jan 1973).

On the basis of the determination of the products from the radiolysis of aqueous oxalic acid solutions, the reaction mechanism was studied. The products are measured at different dose rates with γ-irradiation (20 rad/s) and with pulsed electrons (to about 10^{10} rad/s, 1 μs pulses). Glyoxylic acid, succinic acid, and carbon dioxide are the main products. Emphasis is given to the importance of the reaction of organic radicals with the solute and its influence on the reaction mechanism at different dose rates. The reaction scheme is based on the same type of radicals as observed recently in pulse radiolysis of the system. (auth)

17072 TRAPPING OF RADIATION-INDUCED ELECTRONS IN CYCLOAMYLOSE HYDRATES. ELECTRON SPIN RESONANCE STUDY. Bardsley, J.; Baugh, P.J.; Phillips, G.O. (Univ of Salford, Eng.). J. Chem. Soc., Chem. Commun.; No. 24, 1335-1336(20 Dec 1972).

Electrons produced by γ-irradiation are unexpectedly trapped in solid cycloamylose hydrates at 77 K. (auth)

17073 STRUCTURAL CHANGES IN FROZEN ORGANIC MATRICES AS INVESTIGATED BY RADIOTHERMOLUMINESCENCE AND X-RAY DIFFRACTOMETRY METHANOL + WATER SYSTEM. Kroh, J.; Mayer, J.; Roszak, W.; (and others) (Technical Univ., Lodz, Poland). Int. J. Radiat. Phys. Chem.; 5: No. 1, 59-65(Jan (1973).

Structural changes in the frozen methanol + water system were studied by radiothermoluminescence RTL and low-temperature x-ray diffractometry. Satisfactory correlation between the RTL and x-ray results was obtained. The RTL peaks depend on the structure of the investigated matrix and correspond to its phase transition points. RTL provides a very convenient and sensitive method for the examination of structure and transformations of solid matrices. (auth)

17074 RADIOLYSIS OF LIQUID AMMONIA IN BASIC SOLUTION. 2. THE ROLE OF HYDROGEN. de La Renaudiere, J. F.; Belloni, J. (Paris Univ., Orsay, France). Int. J. Radiat. Phys. Chem.; 5: No. 1, 31-39(Jan 1973).

The yield of hydrogen formed by γ-irradiation increases when hydrogen is added to s solution of an amide in liquid ammonia. This increase has been interpreted by the capture of the HN_2, radicals or their ionized form NH^-. According to this mechanism, the possible reactions removing e^-_{am} are inhibited. It was shown that in a solution containing 5×10^{-2} mole dm^{-3} KNH_2 and hydrogen, irradiated at room temperature, ammoniated electrons are formed; their stability is comparable with that of electrons existing in solutions of metals in liquid ammonia. Their stability is such that their concentration increases with dose up to the point when, seen by the naked eye, their blue color adds to the yellow of the amide. The measured initial yield $G(e^-_{am})$ does not increase with the pressure of hydrogen up to 0.5 atm (5×10^4 N m^{-2}), and for the concentration 5×10^{-2} mole dm^{-3} KNH_2 it becomes $G(e^-_{am}) = 0.75$. (auth)

17075 RADIOLYSIS OF LIQUID AMMONIA IN BASIC SOLUTION. 1. EFFECT OF pH. Belloni, J.; de La Renaudiere, J.F. (Paris Univ., Orsay, France). Int. J. Radiat. Phys. Chem.; 5: No. 1, 23-30(Jan 1973). (In French).

In liquid ammonia containing amide, the yield of hydrazine is higher and the yield of hydrogen and nitrogen smaller than in neutral solution. The stationary concentration of N_2H_4 is much higher than in neutral or acid solution, attaining 0.10 mol dm^{-3} in the presence of 2×10^{-2} mole dm^{-3} KNH_2. The discussion shows that the yield variations with pH have their origin in the replacement of H atoms by e^-_{am}, the former being able, as opposed to the second, to react with N_2H_4 to form H_2. The initial yields $G_{N_2H_4} = 0.30$ and $G_{NH} = 0.34$ are the same as in the neutral solution. (auth)

17076 RADIATION-INDUCED OXIDATION OF PLUTONIUM(III) IN SULPHURIC ACID SOLUTIONS. Mazumdar, A. S. G.; Srinivasan, B.; Natarajan, P. R. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Phys. Chem.; 5: No. 1, 51-58(Jan 1973).

The effect of radiation on 10^{-3} mol dm^{-3} Pu(III) solutions in 0.4 mol dm^{-3} H_2SO_4 was studied both in the presence and in the absence of air. The radiolytic yields of Pu(IV), H_2O_2 and H_2 were measured at different doses and the initial yields were found to be as follows: in the presence of air, G[Pu(IV)] = 6.6 ± 0.6, $G(H_2O_2)$ = 4.0 ± 0.4; in the absence of air, G[Pu(IV)] = 5.5 ± 0.3, $G(H_2O_2)$ = 0.8 ± 0.1, $G(H_2)$ = 3.6 ± 0.3. The results were interpreted to show that Pu(III) is oxidized by OH radicals to Pu(IV) both in the presence and absence of air. H atoms in the presence of air (through HO_2,radicals) oxidize Pu(III) giving rise to Pu(IV) and H_2O_2, while only a part of H atoms appear to oxidize Pu(III) in the absence of oxygen. Irradiations of 10^{-3} mol dm^{-3} Pu(III) solutions in mixtures of sulphuric and hydrochloric acids (total acidity 0.8 equiv. dm^{-3}) were also carried out in the presence of air and the radiolytic yields of Pu(IV) and H_2O_2 were found to be practically the same as those obtained in the absence of chloride ions. (auth)

17077 γ-RADIOLYSIS OF CRYSTALLINE OLEIC ACID. Faucitano, A.; Locatelli, P.; Perotti, A.; Faucitano,Martinotti, F. (Univ., Pavia, Italy). J. Chem. Soc., Perkin Trans., II; No. 12, 1786-1791(1972).

The γ-radiolysis of crystalline oleic acid was studied at -78°C by esr spectroscopy and product analysis. The esr spectra of samples irradiated at -196°C suggest the presence of the radical anion $\sim CH_2-C^{\cdot}\begin{matrix}O^-\\OH\end{matrix}$ doublet superimposed on a poorly resolved pattern due to some other radicals. At -78°C most of the radicals formed at -196°C undergo transformation into allylic radicals, suggesting that hydrogen abstractions are favored in the crystalline lattice of oleic acid even at -78°C. The esr measurements with urea adduct of oleic acid suggest that the radical anion may be the precursor of the σ-type radical $\sim CH_2-C^{\cdot}=O$. The product analysis reveals that dimerization, decarboxylation, and hydrogenation are important radiolytic processes in the solid state; much less important are the reactions involving C–C bond rupture at positions at least twice removed from the carboxy-group and the reactions leading to trans-unsaturations. Comparison with the liquid-state experiments suggests that the mechanism of radiolysis of oleic acid is significantly influenced by the phase state and temperature. (auth)

17078 KINETICS OF THE RADIATION-THERMAL CRACKING OF PARAFFINIC GAS OILS AND STRAIGHT-CHAIN ALKANES. Panchenkov, G. M.; Zhuravlev, G. I. (Moscow Inst. of Petrochemical and Gas Industry). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 6, 829-830(Jun 1972).

Translated from Zh. Fiz. Khim.; 46: No. 6, 1438-1441(Jun 1972).

General equations were derived for the kinetics of the radiation-thermal and thermal cracking of paraffinic gas oils and straight-chain alkanes. The reaction chain length has been calculated, in satisfactory agreement with experiment. (auth)

17079 RADICAL TRANSFER REACTIONS IN γ-IRRADIATED SULPHUR-CONTAINING VINYL POLYMERS. Moenig, H. (Univ., Freiburg i B.); Ringsdorf, H.; Spirk, E. Int. J. Radiat. Phys. Chem.; 5: No. 1, 67-80(Jan 1973).

The formation and behavior of radiation-induced free radicals in statistical copolymers of vinylmercaptan with vinylpyrrolidone in fractions of 1 : 1, 1 : 4, and 1 : 10 was studied at 77°K and at room temperature using electron spin resonance spectroscopy. In these investigations also homopolymers and molecular mixtures of polyvinylpyrrolidone with mercaptosuccinic acid were included. After a γ-irradiation of the copolymers at 273°K neutral sulphur radicals of the type RS˙ could be detected. The relative yield of these radicals increases with the growing content of vinylpyrrolidone. Investigations on the behavior of radicals with an annealing procedure following irradiation at 77°K revealed that two mechanisms are responsible for the formation of RS˙ radicals. On the one hand, these free radicals may be produced by ion radicals which are localized at the mercapto groups after an irradiation at 77°K, and, on the other, they may be formed by chain transfer reaction. The latter process may be regarded as a repair mechanism for the radiation induced C_α-radicals in the vinylpyrrolidone moieties by the mercaptogroups. (auth)

17080 RADIOLYTIC YIELDS $G(HNO_2)$ AND $G(H_2O_2)$ IN THE AQUEOUS NITRIC ACID SYSTEM. Bhattacharyya, P. K.; Saini, R. D. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Phys. Chem.; 5: No. 1, 91-99(Jan 1973).

The gamma radiolysis of aqueous nitric acid in the presence of sulphanilamide (SA) was investigated as a function of dose, and of nitric acid and SA concentrations. Both $G(HNO_2)$ and $G(H_2O_2)$ values were determined at different concentrations of nitric acid in the presence of 0.02 mole dm^{-3} SA. It was found that SA reacts with OH radicals and with hydrated electrons [$k(e^-_{aq}$ + SA) = 3.5×10^9 dm^3 $mole^{-1}$ s^{-1}] without affecting $G(HNO_2)$ in the present system. The $G(HNO_2)$ value increases with increase of nitric acid concentration up to 8 mole dm^{-3}, whereas $G(H_2O_2)$ remains nearly unaffected. The results are discussed. (auth)

17081 RADIOLYSIS OF PERFLUOROMETHYLCYCLOHEXANE. 1. RADIOLYTIC PRODUCTS. Gehringer, P. (Institut fuer Chemie, Seibersdorf, Austria); Proksch, E.; Krenmayr, P. Int. J. Radiat. Phys. Chem.; 5: No. 1, 113-125(Jan 1973).

The products formed during gamma radiolysis of perfluoromethylcyclohexane contained in glass ampoules have been isolated and their structure has been elucidated as far as possible by gas chromatography, mass spectroscopy, NMR and ir measurements. The main radiolytic products from degassed as well as from not degassed samples are: the dimeric products $C_{14}F_{26}$ and $C_{14}F_{28}$, the methylated starting material perfluorodimethylcyclohexane (mainly 1,1-perfluorodimethylcyclohexane), and carbon tetrafluoride. Two more main products, silicon tetrafluoride and carbon dioxide, are formed in larger quantities only from not degassed samples. (auth)

17082 ALTERNATING COPOLYMER GRAFTING ONTO POLYMER FILMS BY A VAPOR-PHASE GRAFTING TECHNIQUE. Yamakita, H.; Hayakawa, K. (Government Industrial Research Inst., Nagoya, Japan). J. Polym. Sci., Polym. Lett. Ed. 10: No. 11, 823–828(Nov 1972).

The γ-induced alternating copolymer grafting of ethylmaleimide–indene, maleic anhydride–indene, acenaphthylene–maleic anhydride, 1,1-diphenylethylene–maleic anhydride on polypropylene films and indene–ethylmaleimide on teflon films was studied. Results suggest that at the beginning of the grafting by γ-irradiation, only indene was sorbed to polyethylene film, but, after an initial grafting period, the sorption of ethylmaleimide occurred and the alternating addition of ethylmaleimide and indene was facilitated. (DHM)

17083 RADIATION CHEMISTRY OF MACROMOLECULES. VOLUME I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972). 381p. $23.00.

Separate abstracts were prepared for 13 of the 14 chapters. The introductory chapter discusses the importance of macromolecular radiation chemistry and the relationship between the radiation chemistry of low- and high-molecular-weight compounds. (MCG)

For abstracts of individual papers see: 17084 through 17096.

17084 EARLY PROCESSES IN RADIATION CHEMISTRY AND THE REACTIONS OF INTERMEDIATES. Williams, F. (Univ. of Tennessee, Knoxville). pp 7-23 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

The particulars of energy absorption are discussed and the main classes of intermediates formed in radiation chemistry are described. The track structure formed by charged particles is considered. Excitation by charged particles, fates of low-energy electrons, kinetics of reactive species in the condensed phase, and processes in rigid media, including macromolecules, are discussed. (47 references) (MCG)

17085 ENERGY TRANSFER IN POLYMERS. Partridge, R. H. (National Physical Lab., Teddington, Eng.). pp 25-54 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

Charge transfer and excitation energy transfer in radiation chemistry are discussed and compared. Experimental observations of energy transfer in polymers are reported. (131 references). (MCG)

17086 THEORY OF FREE RADICALS. Hedvig, P. (Research Inst. for Plastics, Budapest). pp 55-72 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

The basic theoretical aspects of free radical structures are discussed and illustrated by selected examples. The considerations are centered on the structure of aliphatic radicals. Topics covered include: molecular orbital theory, spin density, hybrid orbitals, the ĊH fragment, hyperconjugation of the methyl group, structure of some higher alkyl radicals, exchange interactions, and problems of polymeric radicals. (MCG)

17087 MOLECULAR MOBILITIES IN POLYMERS. Hedvig, P. (Research Inst. for Plastics, Budapest). pp 73-92 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

Mobilities of different parts of polymer molecules and rearrangements of the structure of the amorphous and crystalline phases are discussed. Topics covered include: multiple dispersion regions in polymers, the phenomenological theory of the relaxation processes, temperature dependence of the relaxation

time, microscopic theories, the defect model, and mobility theories. (MCG)

17088 THEORY OF REACTIONS IN THE SOLID STATE. Wintle, H. J. (Queens Univ., Kingston, Ont.). pp 93-107 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

The main physical ideas, in particular the role of reaction cross sections, behind the formal theory of reactions are set out with a minimum of detailed mathematics. The law of mass action, the theory of rate processes, diffusion in solids, reaction rates during irradiation, diffusion controlled reactions, charged-particle effects, and problems of surfaces and dislocations are discussed. (MCG)

17089 THEORY OF THE ELECTRICAL CONDUCTIVITY OF POLYMERS. Wintle, H. J. (Queen's Univ., Kingston, Ont.). pp 109-126 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

The band theory and the mobility theory are discussed. Carrier production and transport, photoelectric effects, absorption currents, electrets, trapping, and related processes are considered. Photoconductivity induced by x, γ, β, or cathode rays is emphasized. (90 references) (MCG)

17090 ELECTRICAL CONDUCTIVITY OF IRRADIATED POLYMERS. Hedvig, P. (Research Inst. for Plastic, Budapest). pp 127-144 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

Radioinduced conductivity in polymers and permanent changes of conductivity after irradiation are described. Experimental data are reviewed. (78 references) (MCG)

17091 ESR AND OPTICAL STUDIES OF TRAPPED ELECTRONS IN GLASSES AND POLYMERS. Keyser, R. M. (Union Carbide Corp., Oak Ridge, TN); Tsuji, K.; Williams, F. pp 145-191 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

Recent work that provides direct spectroscopic evidence for electron trapping in glasses and polymers is considered. A brief survey of trapped electrons in organic glasses and a comprehensive account of the characterization and properties of trapped electrons in γ-irradiated polymers, with particular reference to polyethylene, are presented. It does not appear possible to assign the electron trap in polymers to a specific type of void or defect at the present time. (61 references). (MCG)

17092 THERMOLUMINESCENCE IN POLYMERS. Partridge, R. H. (National Physical Lab., Teddington, Eng.). pp 193-222 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

Thermoluminescence is produced by irradiation of a sample at low temperature and allowing the sample to warm up. The roles of electron traps, molecular motion, and structural transitions in thermoluminescence are discussed. Glow-peak equations are presented and thermoluminescence variation with dose is considered. Some studies on various common polymers are reviewed. (74 references) (MCG)

17093 STATISTICAL THEORIES OF CROSS-LINKING. Saito, O. (Chuo Univ., Tokyo). pp 223-261 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

Degradation, crosslinking, and end-linking of polymers and crosslinking of copolymers are discussed. (MCG)

17094 EXPERIMENTAL TECHNIQUES. Dole, M. (Baylor Univ., Waco, TX). pp 265-286 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

Radiation cells and techniques and radiation dosimetry are discussed. The analytical techniques described include gas analysis and ir, uv, ESR, and NMR spectroscopy. (MCG)

17095 RADIATION CHEMISTRY OF LINEAR POLYETHYLENE. Mandelkern, L. (Florida State Univ., Tallahassee). pp 287-334 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

The conformational, structural, and morphological properties of linear polyethylene are discussed. Radioinduced gel formation, chain scission, hydrogen evaluation, crosslinking and development of internal chain unsaturation are considered. (111 references) (MCG)

17096 FREE RADICALS IN IRRADIATED POLYETHYLENE. Dole, M. (Baylor Univ., Waco, TX). pp 335-347 of Radiation Chemistry of Macromolecules. Vol. I. Dole, Malcolm (ed.). New York; Academic Press, Inc. (1972).

Types and identification of free radicals, G values, kinetics of decay, and mechanisms of formation are discussed. (MCG)

17097 RADIATION-CHEMICAL FIXATION OF MOLECULAR NITROGEN. Podkhyualsin, A. T.; Trishkin, A. E.; Vereshchinskii, I. V. (Inst. of Chemical Physics, Moscow). Int. J. Radiat. Phys. Chem.; 5: No. 1, 3-14(Jan 1973). (In Russian).

The action of 340 kV electrons or γ ^{60}Co on gaseous mixtures of molecular nitrogen with various hydrocarbons gives rise to radiation fixation of nitrogen. In all cases hydrocyanic acid is the main low molecular weight product of fixation. The radiation-chemical yield G(HCN) depends on the nature of the hydrocarbon and the ratio of components. The maximum G(HCN) values are obtained when the nitrogen/hydrocarbon ratio is 10:90. Most of the experiments were carried out under an absolute pressure of 2 atm (200 kN m^{-2}). The addition of inert gases to the mixtures increases G(HCN), which is 1.48 for a mixture of 5% CH_4, 5% N_2 and 90% Ar. Replacing nitrogen by air in the mixtures containing methane leads to a practically complete inhibition of HCN production due to interaction of methyl radicals and oxygen. Oxygen manifests the opposite effect in the case of mixtures of nitrogen with unsaturated hydrocarbons. To elucidate a possible role of reactions of the methylene radical and atomic nitrogen, HCN synthesis in ketene-nitrogen mixtures was studied. A maximum of G(HCN) = 1.6 is reached with 10% of ketene. The addition of small concentrations of N_2O to the mixtures of ethylene and nitrogen has the usual inhibition action. But when using N_2O as a nitrogen-containing component in the mixtures with ethylene, the maximum G(HCN) is three times larger than that from $C_2H_4-N_2$ mixtures. It is 1.6 times smaller when replacing nitrogen by nitrous oxide in the mixtures with methane. Ammonia is also formed in hydrocarbon–nitrogen mixtures; $G(NH_3)$ is comparable to G(HCN) for N_2-CH_4 mixtures. (auth)

17098 PRODUCTION OF NITROGEN BY SECONDARY IONIC PROCESSES IN THE RADIOLYSIS OF HYDROCARBON SOLUTIONS OF NITROUS OXIDE. Infelta, P. P.; Schuler, R. H. (Carnegie-Mellon Univ., Pittsburgh). Int. J. Radiat. Phys. Chem.; 5: No. 1, 41-50(Jan 1973).

An expression is derived to describe the concentration dependence for the production of nitrogen from nitrous oxide solutions in hydrocarbons. This derivation is based on the assumptions that electrons are initially captured by the nitrous oxide to produce one equivalent of nitrogen and that additional nitrogen is then produced as a result of secondary ionic reactions with the nitrous oxide. Given that the secondary reactions involve ionic intermediates, the derived expression is exact and quantitatively takes into account the competition between the secondary reactions of the anions and charge neutralization by the positive-ion partners of their parent electrons. At high nitrous oxide concentrations, three parameters are critical to the evaluation of the predicted yields: G_{gi}, the yield of geminate ion pairs; α_{N_2O}, a constant proportional to the rate constant for electron scavenging by N_2O; and β, a constant proportional to the rate constant of the secondary reaction. If α_{N_2O} is taken as 10 dm^3 mol^{-1}, as indicated by competitive experiments against the methyl halides, then good agreement with experiment is obtained with $G_{gi} \approx 4.2$ and $\beta \approx 8$ dm^3 mol^{-1}. The latter parameter corresponds to a rate constant of 1×10^{10} dm^3 mol^{-1} s^{-1} for the secondary ionic process. The geminate ion-pair yield indicated (4.2) is ≈10% higher than that given by independent electron scavenging studies with alkyl halides (3.8) so that considerable uncertainty as to the degree of applicability of the model exists. Data from N_2O concentrations in the region 10^{-3} to 10^{-2} mol dm^{-3} show that if the intermediate is ionic in character it must have a lifetime (or reaction period) in excess of 2×10^{-8} s. (auth)

17099 RADIOCHEMICAL GRAFTING OF ACRYLONITRILE ON TEXTILE MATERIAL IN HETEROGENEOUS SYSTEM. Stanciu-Stoian, Elena (Academy of Economic Studies, Bucharest); Vlagiu, I.; Petrus, Ileana; Niculescu, Emilia. Rev. Roum. Chim.; 15: No. 7, 1077-1085(Jul 1970).

The kinetics of radiochemical grafting of acrylonitrile on a cellulose textile in the 20 to 50°C range and in a dose field varying from 10^5 to 10^6 r were studied. Among the reaction sensitizers used were substances of the alcohol, acid, and aromatic hydrocarbon class; the percentage of grafted monomer decreases with the increase in the number of carbon atoms of the chain. The reaction was carried out in the presence and absence of air. (auth)

17100 pH EFFECT ON THE RADIOCHEMISTRY OF NEUTRON-IRRADIATED PERMANGANATE SALTS. Cogneau, M. A.; Ladrielle, T. G.; Apers, D. J.; Capron, P. C. (Univ., Louvain, Belguim). Radiochim. Acta; 18: No. 1, 61-63(Dec 1972).

A study of the chemical distribution of ^{56}Mn in neutron-irradiated silver, rubidium, cesium, lithium, barium, and sodium permanganate showed that no manganese dioxide was formed by primary processes (recoil and immediate recombination). The absence of pH effect is confirmed, as far as retention values are concerned,

and pH will only influence secondary reactions such as desorption and oxidation. (DHM)

17101 ELECTRON SPIN RESONANCE AND ELECTRONIC STRUCTURE OF ORGANIC RADICALS CONTAINING α-BROMINE ATOMS. Mishra, S. P.; Neilson, G. W.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Amer. Chem. Soc.; 95: No. 2, 605-606 (24 Jan 1973).

A wide range of aliphatic bromides were studied after exposure to ^{60}Co γ rays at 77°K and ESR spectra were obtained that are clearly characteristic of $R_2\dot{C}Br$ radicals. Data are tabulated for α-bromo radicals found in irradiated bromomethane and bromoethane in deuterated methanol, bromomaleic acid, bromoacetic acid, and 2-bromopropionic acid. (DHM)

17102 ION–MOLECULE REACTIONS IN ISOPROPANOL: IMPLICATIONS FOR ITS RADIOLYSIS. Gorden, R. Jr.; Sieck, L. W. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 76A: No. 6, 655-659(1972).

The photoionization of isopropanol (i-PrOH) at 11.7 eV was investigated in the NBS high pressure photoionization mass spectrometer over the pressure range 0.1 to approximately 200 millitorr. The major primary ion, CH_3CHOH^+, reacts with a total rate coefficient of $1.1 \pm 0.1 \times 10^{-9}$ cm^3/molecule · s to yield mainly (i-PrOH)H^+ and $CH_3(i\text{-}C_3H_7)COH^+$. At pressures in excess of a few millitorr consecutive reactions of (i-PrOH)H^+ and $CH_3(i\text{-}C_3H_7)COH^+$ were also detected, including the overall dehydration process (i-PrOH)H^+ + i-PrOH → H_2O + $(i\text{-}C_3H_7)_2OH^+$. These data are interpreted in light of a recent radiolysis study, and a thermal cationic chain mechanism for production of $(i\text{-}C_3H_7)_2O$ consistent with those results is proposed. The value for the proton affinity of SF_6 is also discussed in some detail. (auth)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

Refer also to abstract 17100.

17103 (COO-2092-3) DYNAMICS OF CHEMICAL REACTIONS. Technical Progress Report, January 1-December 31, 1972. Lee, Y. T. (Chicago Univ., Ill.). 1972. Contract AT(11-1)-2092. 8p. Dep. NTIS.

Progress is reported for the five programs: dynamics of atom molecule reactions; intermolecular potentials; inelastic scattering of atoms and molecules; high energy collisions—hot atom chemistry; and collisions of metastable atoms and molecules. The operation of a time-of-flight velocity analyzer and monoenergetic metastable atom beam source added experimental sophistication. (auth)

17104 HYDROGEN ATOM ABSTRACTION BY FLUORINE ATOMS. Williams, R. L.; Rowland, F. S. (Univ. of California, Irvine). J. Phys. Chem.; 77: No. 3, 301-307(1 Feb.1973).

The relative rates of abstraction of hydrogen atoms by ^{18}F atoms were measured for H_2, D_2, CH_4, CD_4, C_2H_6, CH_3CF_3, H_2S, and HI vs. the rate of addition to acetylene. The measurements have involved the competitive diminution in yield of $CH_2{=}C\dot{H}^{18}F$ (from $CH^{18}F{=}CH$ + HI) vs. RH(or RD)/C_2H_2 ratio. The samples contained excess SF_6 that served both as the target for formation of ^{18}F by the ^{19}F(n,2n)^{18}F nuclear reaction and as the moderator for the excess recoil energy of these ^{18}F atoms. The relative rates per H or D atom varied from 0.018 ± 0.004 for CH_3CF_3 to 0.65 ± 0.05 for H_2S. The abstraction of H was favored over D for both isotopic pairs of molecules: for H_2/D_2 and for CH_4/CD_4. No reaction was observed for ^{18}F with xenon. (auth)

17105 RECOIL CHEMISTRY AND SOLID STATE ISOTOPE EXCHANGE IN A TWO-CENTERED COBALT(III) COMPLEX. Kishore, K.; Venkateswarlu, K. S. (Bhabha Atomic Research Centre, Trombay, India). Radiochem. Radioanal. Lett.; 13: No. 1, 17-24(30 Jan 1973).

Recoil chemistry of ^{60}Co in a two centered complex, viz., $[Co(III)(NH_3)_6]$ $[Co(III)(gly)_2(NO_2)_2]$ showed that thermal annealing into the anionic part is a preferred process. The study indicates the importance of chemical considerations during annealing–exchange. (auth)

17106 KINETIC STUDIES OF THE CHEMICAL BEHAVIOR OF ^{51}Cr IN ORGANIC SOLUTIONS OF NEUTRON-IRRADIATED TRISACETYLACETONATOCHROMIUM(III). Omori, T.; Yeh, Y. C.; Shiokawa, T. (Tohoku Univ., Sendai). Radiochim. Acta; 18: No. 1, 1-5(Dec 1972).

The reformation reaction of the recoil ^{51}Cr atoms in organic solution of neutron-irradiated trisacetylacetonatochromium(III) was investigated in detail by means of a combination of solvent extraction and ion-exchange methods, and it was compared with thermal annealing reaction in the solid phase. The reformation curves of the parent complex in the organic phase are very similar to the annealing isotherms in the solid phase. On the basis of kinetic analysis of the reformation reaction in the organic phase, the existence of polymeric acetylacetonate complexes in the solid phase is suggested. (auth)

17107 CHEMICAL EFFECTS OF THE REACTION $^{127}I(n,\gamma)^{128}I$ IN MIXTURES OF IODINE AND BENZENE. Uenak, T.; Llabador, Y. (CNRS, Strasbourg). Radiochim. Acta; 18: No. 1, 5-11(Dec 1972). (In French).

The yields of organic ^{128}I-iodides formed in neutron-irradiated mixtures of iodine and benzene in solid, liquid, and gas phase were determined. In condensed medium, the results are interpreted on the basis of the local autoradiolysis model. In the gaseous phase, the total organic yield is only 0.19% and results from radical reactions rather than hot reactions. (auth)

17108 INVESTIGATION OF HOT ATOM EFFECTS IN PHTHALOCYANINE COBALT(II) UTILIZING MOESSBAUER SPECTROSCOPY. Thompson, J. L.; Ching, J.; Fung, E. Y. (Idaho State Univ., Pocatello). Radiochim. Acta; 18: No. 1, 57-58(Dec 1972).

From results of a Moessbauer study of hot atom effects in electron capture decay of phthalocyaninecobalt(II) (CoPc) it was concluded that the ^{57}CoPc complex is remarkably resistant to disruption by hot atom effects associated with the electron capture decay reaction. Migration and replacement reactions by daughter ^{57}Fe atom do not seem to occur, and any atomic displacement or charge build-up does not persist as long as 10^{-7} sec. (DHM)

17109 REACTIVE ISOTOPE EFFECT IN NUCLEAR RECOIL ^{18}F REACTIONS WITH CH_4 AND CD_4 TO PRODUCE CH_3F AND CD_3F. Spicer, L. D. (Univ. of Utah, Salt Lake City); Suida, A. Radiochim. Acta; 18: No. 1, 16-19(Dec 1972).

The absolute yields of single replacement products $CH_3^{18}F$ and $CD_3^{18}F$ were determined in highly moderated systems for the reaction of ^{18}F with CH_4 and CD_4 respectively. Carbon tetrafluoride moderator was used in dilutions of up to 98%. The ratio of yields indicates that a reactive isotope effect exists and favors reaction with CH_4 over CD_4 by about 30%. The ratio of yields at 50% dilution with carbon tetrafluoride indicates that any moderating isotope effect is small. (auth)

17110 ROOM TEMPERATURE ANNEALING PROCESS OF RECOIL FRAGMENTS IN NEUTRON IRRADIATED AMMONIUM CHROMATE. Suh, I. S.; Kim, N. B. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 4, 322-326(Dec 1972).

The retention of ^{51}Cr as chromate after dissolution of irradiated ammonium chromate was studied with respect to reactor exposure time and storage time at room temperature. The annealing process of ammonium chromate depending on various storage time at room temperature follows first-order kinetics from zero time value to the pseudo-equilibrium value. The retention is increased with reactor irradiation time, also following first-order kinetics. (auth)

Properties of Radioactive Materials

Refer also to abstract 17230.

17111 (BNWL–1693) RADIATION CHARACTERISTICS OF REACTOR PRODUCED RHODIUM, PALLADIUM, RUTHENIUM, AND TECHNETIUM. Roberts, F. P. (Battelle Pacific Northwest Labs., Richland, Wash.). Oct 1972. Contract AT(45-1)-1830. 27p. Dep. NTIS.

The radiation characteristics of reactor-produced rhodium, palladium, ruthenium, and technetium are reviewed for their potential utilization as substitutes or supplements for conventional resources. The isotopic compositions of rhodium and palladium produced in a typical light-water reactor were experimentally determined. The half-life of ^{102m}Rh was measured, and a value of 3.4 years was obtained. Measured dose rates of the fission products palladium and technetium were obtained, and dose rates for rhodium were calculated. Examination of the radiological hazards associated with these fission products indicates that utilization is possible; but that restrictions must be applied to prevent injury to workers, dispersion of radioactivity to the environment, and contamination of the world's stock of nonradioactive materials. (6 figures, 10 tables) (auth)

17112 ROTOMERIC CONFIGURATIONS OF A METHYL-SUBSTITUTED CYCLOOCTATETRAENE DIANION COMPLEX OF URANIUM(IV). Crystal and Molecular Structure of bis(1,3,5,7-tetramethylcyclooctatetraenyl)Uranium(IV), $U(C_8H_4(CH_3)_4)_2$. Hodgson, K. O.; Raymond, K. N. (Univ. of California, Berkeley). Inorg. Chem.; 12: No. 2, 458-466(Feb 1973).

The crystal and molecular structure of bis(1,3,5,7-tetramethylcyclooctatetraenyl)uranium(IV), $U(C_8H_4(CH_3)_4)_2$, was determined from three-dimensional x-ray data collected by counter methods. There are two crystallographically independent π-carbocyclic sandwich molecules per unit cell. In both cases the uranium atom is symmetrically bonded to two planar, methyl-substituted cyclooctatetraenyl dianion rings. The U–C bond lengths are equal and average 2.658(6) Å. The C–C bond lengths within the four aromatic rings are also equal and average 1.409(7) Å. The two rings in both molecules, when viewed down the molecular symmetry axis, are rotated 14° from a conformation in which the ring carbon atoms are eclipsed. However, the two molecules differ in the relation of the substituent methyl groups. In molecule A the methyl groups are approximately eclipsed and in molecule B the methyl groups are approximately staggered. All 16 independent methyl groups are bent inward an average of 4.1° from the planes of the dianion ring carbons toward the uranium atom. The rotomeric conformation is discussed relative to the well-characterized substituted ferrocenes and two hypotheses are proposed for the nonplanarity of the methyl groups. The complex sublimes easily to give large, burgundy red plates with the following crystal data: monoclinic space group, $P2_1/c$, cell constants a = 20.224 (5), b = 12.066 (3), c = 17.467 (6) Å, β = 101.57 (2)°. For eight formula units per cell the calculated density is 1.74 g/cm^3. The structure was refined with full-matrix least-squares methods using 4341 independent reflections for which $F^2 > 3\sigma(F^2)$ to a standard unweighted R factor of 3.68%. (auth)

17113 STUDIES WITH HEPTAVALENT NEPTUNIUM. Identification and Crystal Structure Analysis of $LiCo(NH_3)_6Np_2O_8(OH)_2 \cdot 2H_2O$. Burns, J. H.; Baldwin, W. H.; Stokely, J. R. (Oak Ridge National Lab., TN). Inorg. Chem.; 12: No. 2, 466-469(Feb 1973).

The compound $LiCo(NH_3)_6Np_2O_8(OH)_2 \cdot 2H_2O$ was precipitated from a LiOH solution of Np(VII) by slowly diffusing in a solution of $Co(NH_3)_6Cl_3$. It was identified by combining elemental chemical analyses and single-crystal X-ray diffraction. The analog containing Na was produced from a NaOH solution of Np(VII), but no similar product was obtained from KOH solutions. The crystals are monoclinic (space group C2/c) with a = 10.739(4), b = 10.450(4), c = 15.013(5) Å, and β = 116°38 (5)'; Z = 4. There are two independent Np atoms in the asymmetric unit, and each is coordinated by an octahedron of O atoms which make four short and two long bonds. These octahedra are linked through two of their O atoms into chains along c with the long axes of the octahedra alternately parallel and perpendicular to the chain. Lithium ions share four O atoms with three octahedra and are also linked to two H_2O molecules, while the $Co(NH_3)_6^{3+}$ octahedra lie between chains and cross-link them. The presence of OH^- ions and H_2O molecules is deduced from structural chemical considerations and chemical analyses. The existence of the $[NpO_4(OH)_2]^{3-}$ ion in solution is proposed and an explanation is offered for the manner in which the crystalline precipitates are formed. (auth)

17114 COMPLEXES OF THORIUM(IV) WITH DICARBOXYLATE LIGANDS IN AQUEOUS SOLUTION. Tomat, G.; Magon, L.; Portanova, R.; Cassol, A. (CNR, Padua). Z. Anorg. Allg. Chem.; 393: No. 2, 184-192(Oct 1972).

Equilibria involved in the interaction of thorium(IV) ion and malonic, succinic, phthalic, maleic, and glutaric acid in aqueous solutions were investigated by means of potentiometric measurements of hydrogen ion concentration at 20°C and in an ionic medium 1 M (H, Na)ClO_4. In the ligand range examined, the formation of chelate complexes with one and two ligands for the thorium(IV)–malonate, –phthalate and –maleate systems and with one ligand only for the thorium(IV)–succinate system was ascertained. For thorium(IV)–glutarate no formation of a chelate, but only of acido complexes occurs, in which the ligand behaves principally as monodentate donor. The formation constants were determined, and the stability of the complexes is discussed. (auth)

17115 CHROMATOGRAPHIC STUDY OF THE PURITY AND STABILITY OF CERTAIN ^{32}P-LABELED ORGANIC THIOPHOSPHATE COMPOUNDS. Iliescu, V.; Turcanu, C. (Inst. of Atomic Physics, Bucharest). Chim. Anal. (Bucharest); 2: No. 1, 29-33(1972). (In Rumanian).

In order to examine the potential applications in insecticides of alkyl dithiophosphates, compounds labeled with ^{32}P were used. The radiophosphorus had high activity and excellent radiochemical purity. The high purity was needed to follow closely the absorption, fixation, and metabolism of insecticides in the pests because the amount of the metabolites available for investigation is usually very small; the high purity ensured that impurities present will not induce undesirable side reactions. Paper chromatography was used for the separation. The compounds were synthetized by taking advantage of the solvolysis of $^{32}P_2S_5$. Eight simple and 4 mixed esters of dialkyl thiophosphoric acid were thus prepared. The R_F values were determined in single, binary, and ternary solvent systems of alcohols and ketones. The data obtained made possible the determination of the stability and the purity of the compounds. (TTT)

17116 SYNTHESIS OF 1-DEUTERIOALDEHYDES FROM METHYLENE-BIS-PYRIDINIUM CATIONS. Olofson, R. A.; Zimmerman, D. M.; Schnur, R. C. (Pennsylvania State Univ., University Park). J. Label. Compounds; 8: No. 3, 397-406 (1972).

A synthesis of 1-deuterio and 1-tritioaldehydes, especially arylaldehydes, from precursor gem-dihalides is described. The scheme is especially useful when high label incorporation is desired. (auth)

17117 STUDIES ON THE PREPARATION AND PERFORMANCE OF INORGANIC ION-EXCHANGE MEMBRANES. Pai, K.R.; Krishnaswamy, N. (Central Salt and Marine Chemicals Research Inst., Bhavnagar, India). Indian J. Technol.; 10: No. 6, 229-232(Dec 1972).

Ion-exchange membranes based on zirconium phosphate, hydrous thorium oxide, and mixed hydrous oxide of aluminium and thorium were prepared by casting and sheeting techniques using poly(vinyl chloride), polystyrene, and cellulose acetate as binders. The use of higher boiling solvents while casting the membranes helped in obtaining more uniform membranes, but the membranes had low electrical conductance. Based on the studies of moisture content, exchange capacity, kinetics of sorption, and flexibility in operation of the ion-exchange membranes, the optimum proportion of poly(vinyl chloride) as binder for zirconium phosphate membranes was found to be 20%. The quantity of anions diffusing into the cation-exchange membranes increased with decrease in the ionic radius and increase in the valency of the cation. The conductance and transference numbers were also measured. Sheeted membranes showed superior electrical conductance. Desalting experiments were carried out in an electrodialysis cell using three pairs of membranes. For a solution of potassium chloride containing 5000 ppM total dissolved solids, a maximum salt removal of 61.8% could be achieved. (auth)

17118 KINETICS OF DISCHARGE OF URANIUM(VI) IN ETHYLENE-BIS-(3-MERCAPTOPROPIONATE) AT d.m.e. Saxena, R.S.; Chaturvedi, U.S. (Malaviya Regional Engineering Coll., Jaipur, India). Indian J. Chem.; 10: No. 7, 755-757(Jul 1972).

The reduction of uranium(VI) at the dropping mercury electrode in ethylenebis-(3-mercaptopropionate) solution was found to be irreversible and diffusion-controlled. The kinetics of electrode reaction was investigated, adopting the treatment followed by Koutecky. The values of ΔG, ΔH, and ΔS calculated at 25°C are 19.5 kcal/mole, 11.0 kcal/mole and 28.0 cal/mole/degree respectively. (auth)

17119 URANIUM(VI) COMPLEXES OF HYDROXYETHYLETHYLENEDIAMINETRIACETIC ACID. Mathur, R.P.; Nath, P.; Kapoor, R.C. (Univ. of Jodhpur, India). Indian J. Chem.; 10: No. 7, 759-760(Jul 1972).

Potentiometric titration of system UO_2^{2+}–HEDTA indicates the formation of the complex species $M(H_2A \cdot OH)^+$, M(HAOH), and $M(AOH)^-$. The values of log K and ΔF at 30 ± 1°C and ionic strength of 0.1M are found to be 6.05 ± 0.28 and −8.44 ± 0.3 kcal/mole respectively. The complexation takes place between pH 2.8 and 6 and is stable up to pH9. (auth)

17120 COMPUTER SIMULATION METHODS IN CHEMICAL KINETICS. APPLICATION TO THE RADIATION-INDUCED REDOX REACTIONS OF NEPTUNIUM. Pages, M. (Institut du Radium, Paris); Carlier, J.; Beaugas, C.; Pages, J. C. Int. J. Radiat. Phys. Chem.; 5: No. 1, 81-90(Jan 1973). (In French).

Computer methods are described, using mathematical models of chemical processes. The example treated here concerns redox reactions of neptunium ions in perchloric acid solution, under α and γ radiation. The computer is used to check the compatibility of the experimental results with the proposed mechanisms and to calculate the best values of rate constants (or ratios of rate constants for competing reactions) for fitting various kinetic models to the experimental results. The simulation language CSMP has been used concurrently with a program for the identification of continuous dynamic systems. (auth)

17121 POLAROGRAPHIC STUDIES IN AQUEOUS MELTS: HALF-WAVE POTENTIALS, DIFFUSION COEFFICIENTS, AND RELATED MEASUREMENTS. Lovering, D.G. (City Univ., London). Collect. Czech. Chem. Commun.; 37: No.11, 3697-3705(Nov 1972).

Half-wave potentials and diffusion coefficients are reported for the reduction of a range of inorganic cations (including UO_2^{2+}) at the d.m.e., in the aqueous melts $Ca(NO_3)_2 \cdot 4H_2O$, $CaCl_2 \cdot 6H_2O$, $LiNO_3 \cdot 3H_2O$ and others. The data for Ni(II) is described and re-

lated spectroscopic measurements provide additional information about the structure of these solutions, especially when compared with previous observations reported for anhydrous melts. Some problems of analysis in very concentrated media are considered. (auth)

17122 REACTION BETWEEN URANIUM(IV) AND NITROUS ACID CATALYZED IRON(III). Koltunov, V. S.; Marchenko, V. I. Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 6, 842-843(Jun 1972).

Translated from Zh. Fiz. Khim.; 46: No. 6, 1465-1467(Jun 1972).

The kinetics of the oxidation of uranium(IV) by nitrous acid in the presence of Fe^{3+} ions were investigated spectrophotometrically in a nitric acid solution at a constant ionic strength I = 3. The reaction is of first order with respect to uranium(IV) and iron(III) and of zero order with respect to nitrous acid. The rate of reaction is inversely proportional to the hydrogen ion concentration. The activation energy for the reaction is 17.8 kcal $mole^{-1}$. The results led to the conclusion that the oxidation of uranium(IV) proceeds via two stages and its rate is limited by that of the interaction of uranium(IV) and iron(III). (auth)

17123 FORBIDDEN VARIABLE COMBINATIONS IN PLUTONIUM CHEMISTRY. Silver, G. L. (Mound Lab., Miamisburg, OH). AT-33-1-Gen-53. Radiochem. Radioanal. Lett.; 13: No. 1, 7-15(30 Jan 1973).

All two membered combinations of solution acidity values with plutonium oxidation number (N), solution oxidation–reduction potential (E) or fraction of one plutonium oxidation state (F) are possible. Not all two membered combinations of N, E, and F are possible, however. Graphs are presented for plutonium in aqueous solution (hydrolysis neglected) which may be used to predict variable combinations which are forbidden. (auth)

17124 CRYSTAL AND MOLECULAR STRUCTURE OF URANYL OXALATE TRIHYDRATE. Jayadevan, N. C.; Chackraburtty, D. M. (Bhabha Atomic Research Centre, Bombay). Acta Crystallogr., Sect. B; 28: No. 11, 3178-3182(1972).

Uranyl oxalate trihydrate, $UO_2C_2O_4 \cdot 3H_2O$, crystals are monoclinic with lattice parameters a = 5.623 (5), b = 17.065 (2), c = 9.451 (3) Å, and β = 98.74 (1)°. The space group is $P2_1/C$ with Z = 4. 513 visually estimated reflexions were corrected for absorption and the structure refined by Fourier and least-squares methods to R = 0.079. Each uranium atom exists as a linear $(O-U-O)^{2+}$ ion with five secondary oxygen atoms coordinated to it in a perpendicular plane. The average distances are $U-O_I$ = 1.63 (4) and $U-O_{II}$ = 2.49 (4) Å. The oxalate groups are planar and tetradentate, each bridging two uranyl ions. Only one water molecule is coordinated to the uranium atom. The structure is consistent with the thermal behavior of the compound. (auth)

17125 DETERMINATION OF THE COMPOSITION OF FLUORIDE METAL COMPLEXES EXTRACTED WITH AMINES. Pal'shin, E. S.; Ivanova, L. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 27: No. 10, 1890-1894(Oct 1972). (In Russian).

A method is suggested for determining the composition of zirconium complex compounds extracted with trioctylamine from hydrofluoric acid solutions. Zirconium is extracted as trioctylammonium hexafluorozirconate, $(TOAH)_2ZrF_6$, from diluted H_2F_2 solutions. The method can be used for determining the composition of fluoride complexes of niobium, tantalum, protactinium and some other elements extracted with amines. (auth)

17126 DETERMINATION OF THE STOICHIOMETRY OF URANIUM DIOXIDE BY A COULOMETRIC METHOD. Privalova, M. M.; Kremenetskaya, S. A. Zh. Anal. Khim.; 27: No. 10, 1986-1990(Oct 1972). (In Russian).

A possibility of using a coulometer of TsLA-type for the determination of the stochiometry of uranium dioxide was shown. The regularity of the coulometric determination of a ratio of O:U (tested on analysis of artificial mixtures and samples of dioxide) shows that the method is highly accurate. The sensitivity of the method estimated by fluctuation of a blank determination is 0.0003 oxygen units. The method can be also used for the analysis of sintered samples of uranium dioxide. (auth)

17127 BEHAVIOR OF Tc(IV) ON THE SCALE OF INDICATORS IN A NONCOMPLEXING MEDIUM. Guennec, J. Y. (CEN de Saclay, Gif-sur-Yvette, France); Guillaumont, R. Radiochem. Radioanal. Lett.; 13: No. 1, 33-38(30 Jan 1973). (In French).

Evidence for cationic Tc(IV) ion: $TcOOH^+$ was found by solvent extraction of reduced Tc(VII) perchlorate solution. Hydrolysis constant of this cation is about 10^{-1}. (auth)

17128 RECOVERY OF SULFUR DIOXIDE. Winsche, W. E.; Wirsing, E. Jr.; Wiswall, R. H. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,692,472. 19 Sep 1972. Filed 28 Apr 1971.

A process is described for recovering SO_2 from a gas in which the gas is passed through a bed of reactive UO_2 to absorb the SO_2. The saturated bed is reconstituted by passing sulfur vapor diluted by an inert gas through the bed to reduce it back to UO_2. (auth)

17129 METHOD OF PURIFYING URANIUM HEXAFLUORIDE BY REDUCTION TO LOWER URANIUM FLUORIDES. Ogle, P. R. Jr. (to United States Atomic Energy Commssion). U. S. Patent 3,697,235. 10 Oct 1972. Filed 31 Mar 1960.

A method is described for the purification of uranium hexafluoride contained in gaseous mixtures by reduction to lower uranium fluorides through formation of an intermediate compound having the empirical formula $UF_6N(O)_x$, where x is a number from 1 to 2. (auth)

17130 CHEMICAL EFFECTS ASSOCIATED WITH β^- EMISSION. V. Study of the ^{233}Pa Formed by β^- Decay of ^{233}Th in $ThCl_4$, $ThBr_4$, and ThI_4 Irradiated in a Nuclear Reactor. Carlier, R.; Genet, M. (Institut du Radium, Paris). Radiochim. Acta; 18: No. 1, 11-16(Dec 1972). (In French).

The chemical effects associated with β^- emission: $^{233}Th \xrightarrow{\beta^-} {}^{233}Pa$ was studied on anhydrous thorium tetrahalides (fluoride excepted). Thorium halides are irradiated in a nuclear reactor and dissolved in aqueous solutions, then the oxidation states of ^{233}Pa (+4 and +5) are analyzed by a coprecipitation method. The ratio $^{233}Pa(IV)/^{233}Pa(V)$ was found to depend on the post effects, namely the dissolution pH medium and the dose absorbed by the solids during and after the activation of thorium salts. For a short irradiation of ThX_4 in the reactor, protactinium is formed mainly in pentavalent state, as it can be deduced from the rule of the valence group conservation. A post γ annealing first leads to reduction of $^{233}Pa(V)$ in the solid [up to 80% $^{233}Pa(IV)$] and then this fraction is entirely oxidized when the dose becomes large. Thus the ratio $^{233}Pa(IV)/^{233}Pa(V)$ is only determined by the oxidoreduction behavior of ThX_4 matrices during γ irradiation. The pH effect observed for the dissolution was interpreted to be the oxidation of $^{233}Pa(IV)$ with $[H^+]$ ions locally coming from instantaneous hydrolysis of Th^{4+} ions. For the dose effect an electron-hole mechanism is proposed to explain reduction of $^{233}Pa(V)$ and it is supposed that the production of large amount of molecular halogen (X_2), measured during γ irradiation of ThX_4, is responsible for the oxidation of $^{233}Pa(IV)$ in the solid. (auth)

17131 FUSION PROCESS OF OXIDE COMPOUNDS. Kaiser, G.; Zimmer, E. (to Kernforschungsanlage). German Patent 2,018 953. 26 Apr 1972. (In German).

The patent claims deal with the process of the fusion in acids or brines of slow-soluble or insoluble oxide compounds, in particular metal compounds such as ZrO_2, ThO_2, or the like, mixed oxides such as (Th,U) oxide, (U,Pu) oxide or the like, as well as compounds with the composition $M(I)O \times M(II)_2O_3$ where M(I) is a divalent metal and M(II) is a trivalent metal, such as $FeO \times Cr_2O_3$, $FeO \times Fe_2O_3$ or the like and $M(I)O \times M(II)O_2$ where M(I) is a divalent metal and M(II) a tetravalent metal, such as $CaTiO_3$ or the like, as well as other oxide compounds with two and more metals, possibly also nonmetals as components of the compound; thus characterized in that fusion results at a temperature between about 650 and 800°C using a disulfate–sulfate mixture, whereby the amount of disulfate must at least correspond to the stoichiometric amount in order to convert the oxide into sulfate. It is advantageous to give an excess of difulfate to the fusion, however, this must not exceed 50% of the stoichiometric amount. (Germany)

17132 DIFFERENTIAL THERMAL ANALYSIS: SOME APPLICATIONS TO COORDINATION COMPOUNDS. Wendlandt, W. W. (Univ. of Houston, TX). pp 287-306 of Vistas in Analytical Chemistry. Sastri, M. N. (ed.). New Delhi; S. Chand and Co. (P) Ltd. (1971).

The differential thermal analysis of the following metal complexes are discussed: $M(Py)_2X_2$, where M^{2+} = Cu, Zn, Ni, Co, and Mn, X = Cl^-, NO_3^-, and NCS^-, Py = pyridine; metal ammine complexes; and metal benzohydroxyamates (including $UO_2(BHA)_2$). (DHM)

17133 STUDY ON THE PREPARATION OF TRITIUM LUMINOUS COMPOUND. Kim, J. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 4, 331-339(Dec 1972).

For the syntheses of tritium-labeled polystyrene, the basic material for the preparation of tritium luminous compound, various methods of labeling such as Tesla discharge, Wilzbach exposure, γ irradiation, and uv irradiation were compared with respect to obtaining high specific activity-product. The polystyrene–T(G) obtained by Tesla discharge and by uv irradiation had specific activity of 1 to 1.2 mCi/mg, and these two methods were the most encouraging. Mixing of 1 part of polystyrene–T(G) with 4 parts of ZnS:Cu phosphor, in weight, appeared to be the most suitable ratio in the preparation of luminous compound from the luminosity point of view. When 30 mg. of the luminescent

mixture was applied to a steel plate by using 1 ml. of the selected binder (i.e., 1 g of commercial varnish in 100 ml. of benzene) the luminosity maximum was ca. 20 μL. The prepared luminous compound was confirmed to be practically applicable for mine marker or dark-room light source. (auth)

Radioactive Waste Treatment

17134 (JUL-867-DE) EXPERIMENTAL DETERMINATION OF THE EFFICIENCY OF AN ION EXCHANGE COMPLETE SALT EQUIPMENT FOR THE DECONTAMINATION OF RADIOACTIVE WASTE AND THE EVALUATION OF THE ECONOMY. Dobrevsky, I.; Stipanits, P.; Zange, E.; Mallek, H.; Jablonski, W.; Zaddach, G. (Kernforschungsanlage, Juelich (West Germany). Abt. Dekontamination). Jun 1972. 66p. (In German). Dep. NTIS (U. S. Sales Only).

The ion exchange and decontamination installation handles radioactive aqueous waste from various operational sections of the nuclear center, Juelich. Activities of the waste water rarely exceed one μCi/l. The net efficiency of the installation amounts to 5 m^3/h. Below a salt content of 12 mval/l, the new installation competed economically with the previously-used decontamination through large evaporators. The efficiency can be further enhanced by means of a suitable scavenger and by filters. (HBG)

17135 (SZS-141) [RADIOACTIVE WASTE DECONTAMINATION PROCESSES]. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Sep 1972. 36p. (In German). Dep. NTIS (U.S. Sales Only).

A separate abstract was prepared for each of the five sections presented. (DHM)

17136 (SZS-141, pp 2-13) OPERATING EXPERIENCE WITH THE DECONTAMINATION OF RADIOACTIVE LIQUID EFFLUENTS FROM THE CENTRAL INSTITUTE FOR NUCLEAR RESEARCH, ROSSENDORF, BY CONTACT SOFTENING AND ION EXCHANGE. Sachse, G.; Schlenkrich, H.; Pfefferkorn, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1972. (In German).

The radioactive waste water treatment plant constructed in the Central Institute for Nuclear Research is described. The plant has a capacity of 3 m^3/h and works with a continuous two-stage contact softening and an ion-exchange step. On the basis of the results obtained during 3 years of operation the advantages of the technology chosen, formation of compact precipitation products and prolonged working cycles of the ion exchangers are explained. Finally, experiences with the regeneration of the resins and on studies aimed at using phenolcarboxylic acid exchangers for the removal of Cs are reported. (auth)

17137 (SZS-141, pp 14-20) DIATOMITE FILTRATION: APPLICATION, CALCULATION, AND BEHAVIOUR. Koehn, G.; Knebusch, J. (VEB Wasseraufbereitungsanlagen, Merkkleeberg, Ger.). Sep 1972. (In German).

Because of its filter efficiency and combinability with regard to filter aids, diatomite filtration is especially feasible for the filtration of contaminated water. After a brief description of constructive and engineering pecularities a relation is given that exists between filtration rate and possible filter run and that is suitable for design and calculation. Standard values of the filtration constant are given. (auth)

17138 (SZS-141, pp 21-34) SAVING OF REGENERANTS BY COMPOUND REGENERATION USING WEAKLY DISSOCIATING RESINS. Johannsen, K. H. Sep 1972. (In German).

In order to save regenerants and to avoid decrease of water quality the combination of weakly and strongly dissociating resins is increasingly used for desalinating water of high salt contents. The feasibility of weakly dissociating resins was tested with regard to the decontamination of radioactive liquid effluents by desalination. The applicability of the weakly acid cation exchangers Wofatit CV and CA-20, respectively, and the weak-base anion exchanger Wofatit AD 41 was studied in a laboratory and pilot scale in combination with the strongly acid Wofatit KPS and the strong-base Wofatit SBK, respectively. (auth)

17139 (SZS-141, pp 35-36) POSSIBILITIES OF OPTIMIZATION OF THE FLOCCULATION PROCESS BY MONITORING PHYSICO-CHEMICAL PARAMETERS. Johannsen, K.-H. Sep 1972. (In German).

The flocculation of suspensoids from waste waters is performed with iron and aluminum salts. A series of processes not yet clarified in detail, as there are protolysis of these salts and sorption, leads to the formation of insoluble voluminous hydroxides which adsorb and incorporate the suspensoids. A brief description of some newer ideas of the mechanism of flocculation is given. Several methods of investigation especially those for optimization of the flocculation process in routine operation are discussed. The investigation was primarily aimed at finding optimum flocculation conditions (amount of flocculants, pH value, sedimentation rate, residual turbidity, residual chemical oxygen consumption). The methods discussed include turbidimetry, microscopic photography of the flocs and the measurement of the electrophoretic migration speed as well as of the sedimentation rate. (auth)

17140 (SZS-142) [RADIOACTIVE AEROSOL CONTROL AND RELEASE]. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Sep 1972. 34p. (In German). Dep. NTIS (U.S. Sales Only).

A separate abstract was prepared for each of the five sections presented. (DHM)

17141 (SZS-142, pp 1-14) REMOVAL OF RADIOACTIVE AEROSOLS AND GASES FROM EXHAUST AIR. Ullmann, W.; Schumann, F.; Schwarzbach, R. (Zentralinstitut fuer Kernphysik, Rossendorf, Ger.). Sep 1972. (In German).

The separation of radioactive aerosols, gases, and vapors from exhaust air of nuclear plants is of great importance with regard to environmental protection. A review of the problems of purification of exhaust air is given. The stage of development and the main trends of removal of radioactive aerosols, radioiodine, and radioactive rare gases are dealt with. From this it is concluded that the technical conditions permit a sufficient protection of the environment of nuclear power stations and reprocessing plants. For the future a favorable prognosis can be given too. (auth)

17142 (SZS-142, pp 15-19) STUDIES OF FILTER MATERIALS FOR THE REMOVAL OF AEROSOLS FROM THE EXHAUST AIR OF NUCLEAR POWER PLANTS. Przyborowski, S. Sep 1972. (In German)

The importance of a thorough testing of filter materials used for the removal of aerosols from the exhaust air of nuclear power plants is pointed out. A method is presented for the assessment of penetration depending on particle size and flow rate. The results obtained are discussed. (auth)

17143 (SZS-142, pp 20-28) LABORATORY STUDIES ON THE ADSORPTION OF RADIOIODINE AND IODINE COMPOUNDS ON ACTIVATED CARBON. Schwarzbach, R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1972. (In German).

Activated carbons produced in the GDR are tested with regard to their capability to adsorb radioiodine and radioactive methyl iodide. The physicochemical properties of the available types of activated carbon are summarized. Activated carbons with most favorable properties are selected considering different parameters. It is attempted to improve the adsorptive properties of the selected carbons by preparing them with $Cu(NO_3)_2$, $AgNO_3$, or KI. Furthermore, the influence of water vapor, temperature, and carbon dioxide on the effectiveness of the carbon was tested. Methods and results of the tests are presented. (auth)

17144 (SZS-142, pp 33) REMOVAL OF KRYPTON WITH ACTIVATED CARBON. Schumann, F. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Sep 1972. (In German).

The increasing use of nuclear energy requires the efficient removal of fission noble gases from the exhaust air of nuclear plants. This may be achieved by the adsorption of these gases on surface-active materials. The efficiency of such a dynamic process depends on various parameters as temperature, total pressure, partial pressure of the gas to be separated, flow rate and composition of the carrier gas, partial size of the adsorber and geometry of the adsorber vessel. (auth)

17145 ANION EXCHANGE IN MIXED SOLVENT SYSTEMS. I. STUDY OF THE EQUILIBRIUM DISTRIBUTION. Koprda, V.; Fojtik, M.; Szlaurova, M. (Research Inst. of Industrial Hygiene and Occupational Diseases, Bratislava). Chem. Zvesti; 26: No. 6, 482-493(1972).

The distribution of chloro complexes of corrosion and fission products between anion exchanger and mixed solvent systems was studied by static ion exchange method. Attention was paid to the dependence of this process on the proportion and character of individual components in mixed solutions. The values of equilibrium distribution coefficients were determined for the chloro complexes of 18 of the most important radionuclides of corrosion and fission products in the following systems: anion exchanger Dowex 2X-8–water–hydrochloric acid–methanol, ethanol or acetone. These measurements were carried out in the whole concentration range of individual components. (auth)

17146 METHOD AND FACILITY FOR THE SEPARATION OF RADIOACTIVE CATIONS FROM SOFT SURFACE WATERS IN LARGE PUBLIC UTILITIES BY MEANS OF MULTIBED RAPID FILTER EQUIPMENT. Bernhardt, H.; Baumgaertel, F.; Kretzschmar, W. (to Wahnbachtalsperrenverband). German Patent 1,517,610. 8 Jun 1972. (In German).

A procedure is described for the separation of radioactive cations, particularly for drinking water supply from water reservoirs and natural standing surface waters. The water to be treated is first led over a rubble filter where the colloids are removed, and immediately afterwards over an ion-exchange bed with the same flow direction. Due to the layout of the facility, the ion exchanger can be easily regenerated. Compared with the hitherto known flocculation methods this procedure is much more economical and has a higher degree of decontamination. (Germany)

17147 PARTITION CHROMATOGRAPHY OF URANIUM AND FISSION PRODUCTS OF POROUS STYRENE – DIVINYLBENZENE COPOLYMER. Beranova, H.; Tejnecky, M. (Inst. of Nuclear Research, Prague). Collect. Czech. Chem. Commun.; 37: No. 11, 3579-3589(Nov 1972).

The preparation and the properties of the organic phase, i.e., of the macroporous copolymers of styrene with divinylbenzene swollen in the solutions of tertiary amines in xylene, were investigated and a comparison with gels swollen in TBP diluents was carried out. Equilibrium distribution of uranium and ^{106}Ru was followed in dependence on HNO_3 and HCl concentration in the aqueous phase. Conditions of the separation of uranium from some of its fission products on columns were determined. (auth)

17148 SELECTIVE ION EXCHANGE FOR THE ISOLATION OF CERTAIN ALKALINE EARTHS. Orlandini, K. A. (to United States Atomic Energy Commission). U. S. Patent 3,694,369. 26 Sep 1972. Filed 11 May 1971.

A process is presented for the separation of strontium and barium from other metal values wherein the strontium, barium, and other metal values are dissolved in a solvent solution of water, pyridine, acetic acid, and glycolic acid and the resulting solution is contacted with a cation exchange resin. The strontium and barium are adsorbed on the resin. (auth)

17149 BEHAVIOR OF Cs IN AN ANIONIC EXCHANGE RESIN (PHOSPHOTUNGSTIC ACID). Baltazar Ribeiro, M. E. A.; Sales Grade, M. R. S.; Marques, B. E. pp 943-50 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The behavior of ^{137}Cs in an anionic resin column (phosphotungstic acid) was studied. Results on the exchange capacity of the anionic resin and on the elution of ^{137}Cs with a nitric–ammonium nitrate buffer at several different pH values are presented. The effect of ionic strength was also considered. (France)

17150 ISOLATION OF RADIORUTHENIUM FROM ACETIC ACID–HYDROCHLORIC ACID SOLUTIONS OF FISSION PRODUCT MIXTURES BY ADSORPTION ON ANION EXCHANGERS. Kim, V. J. I. (Technische Univ., Garching, Ger.); Denbsky, G. Radiochim. Acta; 18: No. 1, 42-47(Dec 1972). (In German).

Chlorocomplexes of 3- and 4-valence ruthenium as well as tetrachlorocomplex of nitrosylruthenium are adsorbed on Dowex 1X8 (Cl-form) in the mixed solution of acetic acid (HAc) and hydrochloric acid, whereas elements like Cs, Sr, Ba, Ce, and Eu are not adsorbed. In the high concentration of HAc, the adsorption of ruthenium appears nearly quantitative. Quantitative desorption of ruthenium is achieved by elution with the mixed solution of pyridine and hydrazinhydroxide. The results of this investigation provide the possibility of simple and fast separation of radioruthenium from a number of other elements being radioecologically important. (auth)

17151 (RLO-2225-T-11-3) LIQUID AND GAS PHASE SEPARATIONS I. Progress Report No. 1, October 1, 1971–September 30, 1972. Babb, A. L.; Garlid, K. L. (Washington Univ., Seattle. Dept. of Nuclear Engineering). Oct 1972. Contract AT(45-1)-2225. 99p. Dep. NTIS.

Extensive analysis of random data obtained from two fluorometric detectors measuring the time-varying organic volume fraction at different locations in a pulsed, solvent extraction column was performed. Results show that cross-correlation and cross-spectral density functions are sensitive indicators of process conditions, and may be used in an on-line monitoring system to give an early indication of column flooding or other anomalous behavior. The methods of analysis in particular the incorporation of the Fast Fourier Transform method, and results obtained are described in detail. The effects of hard-limiting the data, i.e., transforming the series of discrete numerical values to a binary series having a value of either +1 or −1, were also examined. Analysis of the statistical functions obtained after the transformation showed that there was little loss of information, and that this would be a very effective way of reducing the computer storage capacity required for an on-line process monitoring system. Gas-phase separations using semi-permeable membranes were investigated for application to the separation of radioactive gases from gaseous waste streams from nuclear reactors or fuel reprocessing plants. This work is in its early stages, however, since several delays were encountered. A new diffusion test cell assembly was designed and constructed, and a different counting cell was assembled. Measurement of actual permeabilities and separation factors is proceeding. (auth)

Radioisotope Production

17152 (KFK-1656) PROJECT ACTINIDES: FIRST SEMIANNUAL REPORT, 1972. PACT Report No. 24. (Kernforschungszentrum, Karlsruhe (West Germany)). Oct 1972. 198p. (In German). Dep. NTIS (U. S. Sales Only).

Work performed during the period is reported under five headings: preparation of breeder material for ^{238}Pu and transplutonium elements (separation of Am, Cm by cation exchange); chemical separation of irradiated transuranium elements; process techniques; target preparation and irradiation ($^{241}AmO_2$/Al cermets, Pu–Al alloys); and developments directed toward practical application. A new reference flux scheme is described for the separation of americium and curium. Experimental work emphasized production of fuel rods for the high-flux reactor program. Improved methods for chemical separation of ^{238}Pu are described as well as the preparation of neptunium targets. Successful testing of a high-pressure ion exchanger with ^{153}Sm and ^{152}Eu is reported. The production of neutron sources for radiotherapy is outlined. Relative large ^{252}Cf sources are produced in cooperation with the European community. (HBG)

17153 (ORNL-4833) TRANSURANIUM PROCESSING PLANT SEMIANNUAL REPORT OF PRODUCTION, STATUS, AND PLANS FOR PERIOD ENDING JUNE 30, 1972. King, L. J.; Bigelow, J. E.; Collins, E. D. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 35p. Dep. NTIS.

A report of the status and the future production plans of the Transuranium Element Production Program at ORNL is presented. TRU operations for January to June, 1972 report period are summarized. Quantities of materials that were recovered and shipped are specified, and proposed processing schedules and anticipated yields of various products are presented. Facilities for special processing, fabrication, and irradiation programs are described. The original and current contents (^{252}Cf and ^{248}Cm) of all neutron sources that have been made at TRU, as well as the individuals to whom these sources have been loaned, are tabulated. Values of nuclear parameters that were used as input data for the calculations of production rates for transuranium elements, along with a listing of the parameters which were used to calculate the specific activities of the isotopes that are of interest to TRU, are included. (auth)

17154 (ORNL-TM-4106) RADIOISOTOPE PROGRAM (8000) PROGRESS REPORT FOR JANUARY 1973. Rupp, A. F. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 17p. Dep. NTIS.

Research progress is reported for ORNL radioisotope production program including reactor-produced isotopes (^{43}K, ^{33}P, and ^{195}Pt), accelerator-produced isotopes (^{206}Bi), fission products, and source development. (DHM)

17155 SEPARATION OF ^{211}At FROM BISMUTH METAL. Neirinckx, R. D. (CSIR, Pretoria, South Africa); Smit, J. A. Anal. Chim. Acta; 63: No. 1, 201-204(Jan 1973).

A method is presented for separating ^{211}At from bismuth metal by diisopropyl ether extraction followed by stripping with hydroxyammonium chloride. The radiochemical purity of the product was checked with the following results. Three hours after production only ^{211}At could be detected by γ spectrometry, after complete decay of ^{211}At, only its decay product ^{207}Bi was detected. Measurement of the α spectra showed that after complete decay of ^{211}At, only 1.5×10^{-6} mCi of ^{210}Po was present (silicon detector) in 50 mCi amounts of ^{211}At. The results of the proposed method are reproducible, an uncommon feature in most of the literature treating chemistry of astatine. (DHM)

17156 PRODUCTION OF ^{167}Tm FOR MEDICAL USE. Chandra, R.; Braunstein, P.; Thein, A.; Tilbury, R.S. (New York Univ., NY). Int. J. Appl. Radiat. Isotop.; 23: No. 12, 553-556(Dec 1972).

A method is described for producing sufficient amounts of ^{167}Tm for medical use in a carrier free form on a small medical cyclotron. Using enriched $^{167}Er_2O_3$ up to 75 μCi/Ahr can be produced. The biological distribution of ^{167}Tm HEDTA in rabbits is also presented. Most of the activity (up to 70%) is localized in the skeleton and the rest is excreted. (auth)

17157 HEALTH PHYSICS PROBLEMS ARISING IN THE PRODUCTION OF LARGE QUANTITIES OF ^{227}Ac. Deworm, J. P.; Fieuw, G. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 195-214 of New Trends in Radiation Protection.

Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

In 1969, a project in which ^{227}Ac was produced by irradiating 50-gram radium samples in the BR2 reactor was initiated. Since then, several grams of ^{227}Ac have been produced and isolated. Health physics problems encountered in the recovery of ^{227}Ac from irradiated pellets in the presence of large quantities of ^{222}Rn and ^{220}Rn (several Cim^{-3}) are reviewed. Such quantities result in special problems. The problems arising from the confinement of ^{226}Ra, ^{228}Th, and ^{227}Ac emanations are considered. A permanent system for monitoring the activity of the air in the working areas is described. A procedure for distinguishing ^{219}Rn, ^{220}Rn, and ^{222}Rn was developed. The observations made during the regeneration of cold emanation traps, and the discharge of the different Rn isotopes into the atmosphere are discussed. The precautions taken during the waste disposal process are explained. (France).

17158 PREPARATION OF ^{99m}Tc FERRIC HYDROXIDE MACROAGGREGATES FOR LUNG PERFUSION STUDIES. Kim, Y. H.; Kim, Y. S.; Kim, Y. K. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 4, 327-330(Dec 1972).

The preparation of ^{99m}Tc ferric hydroxide macroaggregates for lung perfusion studies from Na $^{99m}TcO_4$ that was extracted by methyl ethyl ketone from low activity ^{99m}Mo is described. Particle size was from 20 to 60μ. Rabbit and human body tests gave excellent results. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 16984 and 16985.

17159 (ORNL-TM-3723) VOLOXIDATION: REMOVAL OF VOLATILE FISSION PRODUCTS FROM SPENT LMFBR FUELS. Goode, J. H. (comp.) (Oak Ridge National Lab., Tenn). Jan 1973. Contract W-7405-eng-26. 137p. Dep. NTIS.

Results of studies of the voloxidation process by several ORNL groups are presented. In this process, sheared fuel is heated in air at 450 to 500°C to remove tritium, krypton, xenon, and iodine and, in the case of LMFBR fuel, to oxidize any "tramp" sodium prior to dissolution. Data obtained in preliminary thermogravimetric studies of the oxidation of $(U,Pu)O_2$ pellets containing 20 and 25% PuO_2 showed that significant oxidation took place at temperatures higher than 350°C but that the conversion of UO_2 to U_3O_8, based on weight gain, was not always complete. The data also showed that some mechanically blended pellets disintegrated to a fine powder while others remained intact. Detailed thermogravimetric and x-ray diffraction studies with pellet fragments showed that the oxidation of solid solution $(U_{0.8}Pu_{0.2})O_2$ was a two-stage process, which followed the ternary phase diagram of the U-Pu-O system. The first stage was rapid oxidation to a tetragonal M_3O_7 phase having an O/M ratio of approximately 2.35. The second stage, which resulted in disintegration of the fuel, occurred when the M_3O_7 phase converted to $M_3O_8 + MO_2$. The kinetics involved in the second stage were strongly dependent on temperature, fuel homogeneity, and other factors. At 550°C, the order of ease of oxidation in the second stage was: coprecipitated > sol-gel > mechanically blended pellets. Solid solution $(U_{0.75}Pu_{0.25})O_2$ also oxidized readily to an M_3O_7 or M_4O_{9+x} phase having an O/M of approximately 2.35, but proceeded to higher O/M ratios only with great difficulty; since entry into the $M_3O_8 + MO_2$ phase was not made, the fuel did not pulverize. The behavior of a nonhomogeneous mixture consisting of plutonium-rich regions in a UO_2 matrix was similar to that of UO_2, and disintegration occurred. Other detailed thermogravimetric and x-ray studies were made with whole pellets of coprecipitated, mechanically blended, and sol-gel-derived $(U,Pu)O_2$ having Pu/U + Pu ratios of 0.15 to 0.28. These results confirmed those obtained with pellet fragments, except that the ceramic quality and size of the specimen also affected the rate and degree of oxidation at Pu/U + Pu ratios of $\geq$0.15. High-pressure (500-psi) oxygen at 600°C was used to force the oxidation of a homogeneous $(U_{0.75}Pu_{0.25})O_2$ pellet beyond the M_4O_9 stage to the $M_3O_8 + MO_2$ phase, where pulverization occurred. Hot-cell tests indicated that, in nearly every case, more than 99% of the tritium was released from irradiated UO_2 or $(U,Pu)O_2$ when the fuels were oxidized at temperatures of 350°C and higher. About 98% of the iodine and about 98% of the krypton were volatilized from highly irradiated fuel specimens; however, more typical releases were on the order of up to about 45% of the krypton and 75% of the iodine. (auth)

17160 SEPARATION OF PROTACTINIUM FROM NITRIC ACID NUCLEAR FUEL SOLUTIONS BY ADSORPTION ON VYCOR GLASS. Coenegracht, O.; Kaiser, G.; Merz, E. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik; 14: No. 11, 526-532(Nov 1972). (In German and English).

A study was made of the adsorption performance of weighable quantities of ^{233}Pa on Vycor glass in pure thorium nitrate solutions as well as in the presence of other ions at various concentrations such as are found in the reprocessing of nuclear fuels by the Thorex process. Results show that the proposed process makes it possible to achieve a protactinium separation yield of almost 96% and they provide all information necessary for the design of an industrial facility. (DHM)

17161 PRESENT AND FUTURE APPLICATION OF SOLVENT EXTRACTION PROCESSES FOR THE REPROCESSING OF IRRADIATED NUCLEAR FUELS. Detilleux, E. (European Co. for the Chemical Processing of Irradiated Fuels, Mol, Belgium). Ingenieursblad; 41: 467-475(1972).

Solvent extraction, using tributyl phosphate as extraction medium, is the process universally adopted to recover and purify the plutonium and uranium contained in irradiated nuclear fuels. The extraction process is generally known under the appelation of Purex Process. This process is analyzed to show how it fulfils the specific requirements defined. The permanent evolution of reactor technology modifies some of the characteristics of the spent fuels. The consequences of this evolution on the extraction process are studied together with the means currently developed to secure the further use of liquid-liquid extraction as an industrial process. (auth)

17162 NEPTUNIUM HEXAFLUORIDE AND BEHAVIOR OF NEPTUNIUM IN FLUORIDE VOLATILITY PROCESSING OF NUCLEAR FUELS. Vanka, Miloslav (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 19: No. 1, 17-21(Jan 1973). (In Czech).

Neptunium hexafluoride is a stable compound with physical properties that are very similar to those of UF_6 and PuF_6. Though the reactivity of NpF_6 is intermediate between the two hexafluorides, there are several potential ways of separating Np from the mixture of actinide hexafluorides. Sorption on sodium fluoride or successive selective reduction of PuF_6 and NpF_6 are the most promising methods of neptunium isolation. (auth)

17163 PROCESS FOR PALLADIUM RECOVERY. Panesko, J. V. (to United States Atomic Energy Commission). U. S. Patent 3,694,370. 26 Sep 1972. Filed 21 Jun 1971.

Palladium values are recovered from alkaline Purex supernatant waste feed solutions containing palladium, rhodium, and technetium values by passing the solution through a bed of activated charcoal that selectively sorbs the palladium while permitting the other values to pass through the bed. The palladium values are recovered by elution with water and then with ammonium hydroxide. (auth)

17164 CATION EXCHANGE CONVERSICN OF HYDROXYLAMINE SULFATE TO HYDROXYLAMINE NITRATE. Wheelwright, E. J. (to United States Atomic Energy Commission). U. S. Patent 3,695,834. 3 Oct 1972. Filed 12 Oct 1970.

Hydroxylamine sulfate is converted to hydroxylamine nitrate by passing an aqueous hydroxylamine sulfate solution through a cation exchange resin bed which adsorbs the hydroxylamine, washing the sulfate ion from the resin bed and eluting the hydroxylamine as hydroxylamine nitrate with nitric acid. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 18269, 18913, and 18914.

17165 (IKE–5–132) CERAMIC-METAL JOINTS FOR THERMIONIC CONVERTERS. Knauss, G. (Stuttgart Univ. (West Germany). Institut fuer Kernenergetik). 1971. 32p. (In German). INIS.

Various methods are discussed for the preparation of joints between high-purity Al_2O_3 ceramics and Nb–1% Zr or Vacon for thermionic converters. A new soldering method for the ceramic-metal joints is described. Joints with highest strength have so far been obtained by soldering of tungsten-bonded ceramics and Nb–1% Zr, using Cu–2% Ni (front-side junctions). Cu–2% Ni solder, however, shows unsatisfactory rheological properties in a clearance between the tungsten-bonded ceramic material and Nb–1% Zr. It softens the tungsten bond and the Nb–1% Zr. It is therefore, advisable to use this solder for soldering at the front side, rather than for circumferential solderings of ceramics and Nb + 1% Zr rings, in such a manner that the solder does not flow toward the soldered function. 47.5% Ti–47.5% Zr–5% Be solder, on the other hand, shows excellent wetting and rheological properties, without affecting the tungsten bond or the Nb–1% Zr. It may, therefore, be used for junctions not only at the front side but also for more stable junctions along the circumference of ceramics and Nb–1% Zr rings. (INIS)

17166 (JPRS-57940-1) MAGNETOHYDRODYNAMIC METHOD OF PRODUCING ELECTRICAL ENERGY. PART I. TRANSLATION OF MAGNITOGRIDRODINAMICHESKIY METOD POLUCHENIYA ELEKTROENERGII, 1972, Moscow. 206p. NTIS.

A collection of articles on magnetohydrodynamic generation of energy is presented. The topics discussed are the theory and calculation of flows in a MHD generator operating on an equilibrium plasma, experimental investigation of open-cycle MHD generators, investigations of the physical processes and diagnostics in open- and closed-cycle MHD generators, investigations of the basic equipment of MHD generators, investigations of circuits and cycles of power stations with MHD generators, liquid-metal MHD plants, and material for MHD generators. (JPRS)

17167 (JUL–874–TP) APPLIED MAGNETOHYDRODYNAMICS. VOLUME 9. CALCULATION OF THE CHARACTERISTIC QUANTITY OF THE WORKING GAS OF THE MHD-COMBUSTION GAS GENERATOR. Kuehne, W. D.; Kolb, G. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Jul 1972. 124p. (In German). Dep. NTIS (U. S. Sales Only).

The thermodynamic and electric properties of working fluid of the MHD-combustion gas generator are described. Three practically important gaseous fuels: natural gas, coke gas, and propane were studied. First, the composition of the combustion gas is calculated which yields, from the basic energy balance equation, the adiabatic flame temperature. Subsequently the entropy, specific heat, enthalpy, density, isotrope exponent, electric conductivity, and the Hall parameter are calculated. The composition of combustion gases, flame temperature, and the other factors are presented in numerous diagrams as functions of various operational parameters, such as stoichiometry and degree of oxygen enrichment in the oxidator. The concentration of the seed material was consistently assumed to be 1% in weight. (tr-auth)

17168 (N-72-28685) DIMINIODE: A RESEARCH AND DEVELOPMENT TOOL FOR NUCLEAR THERMIONICS. Morris, J. F. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug 1972. 17p. (NASA-TM-X-2586; E-6862). NTIS.

Diminiodes are fixed- or variable-gap cesium diodes with plane miniature emitters and guarded collectors. In addition to smallness, their relative advantages are simplicity, precision, ease of fabrication, interchangeability of parts, cleanliness, full instrumentation, ruggedness, and economy. With diminiodes and computers used in thermionic performance mapping, a thorough electrode screening program becomes practical. (INIS)

17169 (N-72-28747) HALL CURRENT EFFECTS IN THE LEWIS MAGNETOHYDRODYNAMIC GENERATOR. Nichols, L. D.; Sovie, R. J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jul 1972. 27p. (NASA-TM-X-2606; E-6924). NTIS.

Data obtained in a magnetohydrodynamic generator are compared with theoretical values calculated by using the Dzung theory. The generator was operated with cesium-seeded argon as the working fluid. The gas temperature varied from 1800 to 2100°K, the gas pressure from 19 to 22 N/cm^2, the Mach number from 0.3 to 0.5, and the magnetic field strength from 0.2 to 1.6 T. The analysis indicates that there is incomplete seed vaporization and that Hall current shorting paths (through the working fluid to ground at both the entrance and exit of the channel) limit generator performance. (auth)

17170 (N–72–30038) POWER CONDITIONING EQUIPMENT FOR A THERMOELECTRIC OUTER PLANET SPACECRAFT. Volume 1, Book 1. Final technical report, April 1969–December 1971. Andrews, R. E. (ed.) (General Electric Co., Philadelphia, Pa. Missile and Space Div.). 15 Jun 1972. Contract NAS7-100. 282p. (NASA-CR–127914). NTIS.

For Jet Propulsion Lab., Pasadena, Calif.

Equipment was designed to receive power from a radioisotope thermoelectric generator source, condition, distribute, and control this power for the spacecraft loads. The TOPS mission, aimed at a representative tour of the outer planets, would operate for an estimated 12 y period. Unique design characteristics required for the power conditioning equipment (PCE) results from the long mission time and the need for autonomous on-board operations due to large communications distances and the associated time delays of ground initiated actions. The salient features of the selected power subsystem configuration are: the PCE regulates the power from the radioisotope thermoelectric generator power source at 30 Vdc by means of a quad-redundant shunt regulator; 30 Vdc power is used by certain loads, but is more generally inverted and distributed as square-wave ac power; a protected bus is used to assure that power is always available to the control computer subsystem to permit corrective action to be initiated in response to fault conditions; and various levels of redundancy are employed to provide high subsystem reliability. (auth)

17171 (N–72–30039) POWER CONDITIONING EQUIPMENT FOR A THERMOELECTRIC OUTER PLANET SPACECRAFT. Volume 1, Book 2. Final technical report. Andrews, R. E. (ed.) (General Electric Co., Philadelphia, Pa. Space Div.). 15 Jun 1972. Contract NAS7-100. 395p. (NASA-CR–127868). NTIS.

For Jet Propulsion Lab., Pasadena, Calif.

The design and development of power conditioning equipment for the thermoelectric outer planet spacecraft program are considered. One major aspect of the program included the design, assembly and test of various breadboard power conditioning elements. Among others these included a quad-redundant shunt regulator, a high voltage traveling wave tube dc-to-dc converter, two-phase gyro inverters and numerous solid state switching circuits. Many of these elements were arranged in a typical subsystem configuration and tests were conducted which demonstrated basic element compatibility. In parallel with the development of the basic power conditioning elements, system studies were continued. The salient features of the selected power subsystem configuration are presented. (auth)

17172 METHOD OF MAKING A URANIUM-CONTAINING CATALYST FOR A METAL ELECTRODE. Fukuda, M.; Miura, T.; Takahashi, K. (to Matsushita Electric Industrial Co.). U. S. Patent 3,709,834. 9 Jan 1973. Priority date 26 Aug 1968, Japan. 10p.

An electrochemical electrode adapted for use in fuel cell batteries, metal-air batteries, and electrochemical oxygen-evolution instruments contains an active catalyst that includes uranium and which, in a small amount, exhibits a catalytic activity equal to that obtainable from a larger amount of the conventional catalyst. (9 figures) (Official Gazette)

17173 RESULTS OF SOME TESTS ON INSULATING AND ELECTRODE MATERIALS IN A PLASMA JET. Vysotskii, D. A.; Petrov, M. D.; Rekov, A. I.; (and others) (Inst. of High Temperature, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 562-566(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 635-639(1972).

The electrical characteristics and the erosion and heat resistance of electrode materials based on silicon carbide alloyed with molybdenum, chromium, and titanium and also insulating fireproof concretes based on aluminum and magnesium oxides were studied in a model magnetohydrodynamic-generator channel. The advantages of a sectional construction of the channel were demonstrated. Independently of the type of alkali additive employed (e.g., potassium vapor or potash), at the temperature of condensation of

the additives on the electrode surface the current density was determined by the electrical conductivity of the films of reaction formed by the interaction between the additive and the electrode materials. (auth)

17174 PROBLEMS IN MHD ENERGY CONVERSION. Medin, S. A.; Ovcharenko, V. A.; Shpil'rain, E. E. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 2, 390-410(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 2, 439-459 (1972).

The present review is a brief exposition of the state of the problem of building MHD generators, based on a progress report prepared on the basis of material from the last International Congress, held in Munich in April, 1971. (TFD)

17175 KINETICS OF A TWO-ELECTRODE CELL WITH A FISSION PRODUCT EMITTER. Kostritsa, A. A.; Chekushina, L. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 10-14 (1972). (In Russian).

The change in potential difference with time was studied between electrodes which released fission products and the electrode-collector. Two assumptions were considered in turn: a cell in the form of a spherical condenser and a cell in the form of a cylindrical condenser. (KSW)

17176 ELECTRIC CHARACTERISTICS OF DIRECT-CURRENT MHD GENERATORS OPERATING WITH IONIZED GASES IN STEADY-STATE MODE. Mocanu, C. I.; Dogaru, I. Stud. Cercet. Energ. Electroteh.; 22: No. 3, 673-703(1972). (In Rumanian).

Starting from the generalized equation of electric conductivity in plasma and disregarding the magnetic reaction of the plasma, it is shown that the generator admits the existence of a Joubert-type equivalence scheme, in which the electromotive force corresponds to electromagnetic induction resulting from motion, while the internal resistance is defined on the basis of an isotropic MHD channel model with a homogenous field. The growth factor of the internal resistance of the plasma in the MHD channel, resulting from the anisotropy, is calculated. It is shown that local variations of the electric field within the MHD channel are not sufficient to describe the operating modes of the generator. Mean electric field intensity and current density values are defined on the basis of the integral form of the conductance of a plasma and overall current-voltage diagrams, calculating also the available internal power and the losses due to the electrocaloric effect. The data obtained permit the operation of a MHD generator in a network under steady-state conditions to be evaluated. Operation under transient conditions will be examined in future articles. (TTT)

17177 THERMIONIC ELECTRODES TECHNOLOGY. Schins, H. E. J. (Joint Nuclear Research Center, Ispra, Italy). Forsch. Ingenieurw.; 38: No. 5, 151-153(1972).

In the thermionic two-component system consisting of a refractory metal surface and Cs, the only parameter that allows for an enhancing of efficiency is the nature of the metal surface. Surfaces obtained by the following techniques were studied: (1) radio-frequency inductive plasma sputtering, (2) van der Schueren evaporation, a sublimation technique, and (3) vapor plating. The surfaces obtained by these techniques were studied as to their adhesion and grain size. A modified Shelton retarding current method allows the distribution of work functions to be determined. The improvements in diode-efficiency to be obtained by improving the metal surfaces are probably limited. It was shown that significant improvements can be hoped for by introducing a third component in the system. Thus techniques for the handling of barium were studied. (GF)

17178 PROPOSAL FOR SOLAR ENERGY POWER SYSTEM. Horigome, T.; Nagai, K.; Sawata, S.; Tani, T. Denki Shikensho Iho; 36: No. 10, 718-729(1972). (In Japanese).

Concepts for a satellite solar power system and two solar energy generating stations to meet requirements for future large-scale electrical power generation are discussed. Considerations are given to solar energy conversion, microwave power system, two solar power farm systems with thermal or chemical storage, and electromagnetic wave energy converters. The system design considerations and the development tasks for a large-scale electrical power station are reviewed, and the possibility of meeting technological needs is foreseen. (auth)

Facilities and Equipment

Refer also to abstracts 17239, 17293, 18949, and 19243.

17179 DYNAMIC MODELING OF A LARGE ONCE-THROUGH STEAM GENERATOR. Sanathanan, C. K. (Univ. of Illinois, Chicago); Sandberg, A. A.; Clark, F. H.; Burke, O. W.; Stone, R. S. Nucl. Eng. Des.; 23: No. 3, 321-330(1972).

A mathematical model of a large counter-current heat exchanger for generation of supercritical steam was derived. The model consists of coupled, nonlinear, partial differential equations derived from the laws of conservation of mass, momentum, and energy pertaining to the compressible secondary fluid and the counter-flowing incompressible primary fluid. Boundary conditions on the dependent variables, such as pressure, enthalpy, and velocity, were applied at three different space points. The exchanger was assumed to be coupled with other components of a nuclear power plant. An analog-digital hybrid computer was used to simulate the model of the exchanger. A continuous-space discrete-time (CSDT) approach in the simulation was very effective in handling the boundary conditions. One of the highlights of the simulation was a demonstration of the dependence of computational stability on the dependent variables. (auth)

17180 NEUTRON RADIOGRAPHY AS A DIAGNOSTIC TOOL IN THE STUDY OF CORROSION IN LITHIUM-FILLED HEAT PIPES. Forman, R.; Thaler, L. A. (Lewis Research Center, Cleveland). Mater. Eval.; 31: No. 2, 25-26; 32(Feb 1973).

The use of neutron radiography to investigate the corrosive effect of lithium in high-temperature heat pipes is described. Neutron radiographs of a heat pipe sharply define the lithium-filled regions and provide excellent contrast between the lithium and outer containment vessel. The use of this method allows non-destructive examination of a heat pipe at intervals during its operations, which could aid in detection of corrosion effects by mass transfer. (auth)

17181 CONTINUOUS SINTERING FURNACE. Aubuy, B.; Gillot, J.; Masselot, Y.; Teboul, A. (to Commissariat a l'Energie Atomique). U.S. Patent 3,708,157. 2 Jan 1973. Priority date 8 Aug 1969, France. 6p.

A furnace is described for the continuous sintering of pellets of ceramic nuclear-fuel material containing a binder in a neutral or reducing atmosphere comprised of a horizontal-axis tubular enclosure having heating means distributed along said enclosure and a support plate for the longitudinal displacement of pellet containers. A circulation system for maintaining a neutral or reducing atmosphere and for extracting the binder comprises inlets for injecting neutral or reducing gas at the two ends of the furnace and an outlet for withdrawing gas in an intermediate zone between the presintering and sintering zones. Means associated with a container-introduction lock-chamber placed at one end of the furnace and with an extraction lock-chamber for withdrawing containers at the other end of the furnace cause the containers to travel along the support plate from the introduction lock-chamber to the extraction lock-chamber. (Official Gazette)

17182 EQUIPMENT INCLUDING A FLUIDIZED BED. Lefevre, R. L. R. (to Commission of the European Communities). German Patent 2,140,663. 2 Mar 1972. 9p. (In German).

Equipment for the purpose of bringing a batch of a certain material in contact with a fluidizing agent at high temperatures is described. The kind of equipment with a fluidized bed described uses a fluidized chamber with a large number of inlet openings being symmetrically arranged around the axis in the bottom of the fluidized chamber so that the fluidizing agent passing through these inlets will add a lateral motion to the upward movement of the material forming the fluidized bed. The resultant of these components will keep the material in constant motion around the axis of the chamber, thus retaining it in the chamber. (GF)

Heat Transfer and Fluid Flow

Refer also to abstracts 17179, 17180, 18627, 19130, 19131, and 19306.

17183 (AE-459) TEMPERATURE INCREMENTS FROM DEPOSITS ON HEAT TRANSFER SURFACES: THE THERMAL RESISTIVITY AND THERMAL CONDUCTIVITY OF DEPOSITS OF MAGNETITE, CALCIUM HYDROXY APATITE, HUMUS, AND COPPER OXIDES. Kelen, T.; Arvesen, J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1972. 69p. Dep. NTIS (U. S. Sales Only).

An investigation was carried out in order to study the temperature rise at heat transfer surfaces produced by deposits of magnetite, humus, calcium hydroxy apatite and copper oxides. This investigation was motivated by the operational problems which may arise when deposition causes temperature increments in boiler tubes and nuclear fuel elements. The investigation was carried out in high-pressure equipment at 70 bar and 285°C under boiling conditions. Deposits were formed on a heated test surface. The thermal properties were then evaluated from determinations of temperature rise, thickness of deposit, mass of deposit per unit area and density of heat flow rate. The thermal properties were deter-

mined in the form of thermal resistivity and thermal resistance number. They were also expressed in the form of thermal conductivity and thermal conduction number to facilitate comparisons with literature values. Humus gave the proportionally highest temperature rises, followed by magnetite. Diagrams are presented in which the temperature rise from a deposit can be estimated when the density of heat flow rate and the thickness or the mass per unit area are known. Other diagrams show the influence of the density of heat flow rate and the density on the thermal resistivity. (auth)

17184 (ORO-3936-10) VAPOR EXPLOSION: HEAT TRANSFER AND FRAGMENTATION. TECHNICAL PROGRESS REPORT. Witte, L. C.; Cox, J. E. (Houston Univ., Tex. Dept. of Mechanical Engineering.). Jan 1973. Contract AT(40-1)-3936. 8p. Dep. NTIS.

Work performed on rapid vapor formation during the period February 1, 1972 to January 31, 1973 is described. The areas of study were: highly transient heat transfer from spherical bodies; molten-jet/water interactions, and interactions of molten materials and liquids. Studies have continued both experimentally and theoretically. (auth)

17185 (UJV-2891-R) PRESSURE LOSSES AND HEAT TRANSFER IN NON-CIRCULAR CHANNELS WITH HYDRAULICALLY SMOOTH WALLS. Malak, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Jaderneho Vyzkumu.). 1972. 120p. (In Czech). Dep. NTIS (U.S. Sales Only).

The influence of the channel geometry on pressure losses and heat transfer in non-circular channels with hydraulically smooth walls was studied. As a basic assumption for the description of this influence, new integral geometrical criteria, selected according to experimental experience, were introduced. Using these new geometrical criteria a large set of experimental data for pressure losses and heat transfer in circular and annular channels with longitudinal fins was evaluated. In this way it was empirically proved that the new criteria described channel geometry fairly. Dimensionless relationships for friction coefficient and Nusselt number, Nu, expressed by means of these criteria have therefore universal validity. The universality of new dimensionless relationship for the friction coefficient has been confirmed by adequate transformation of all obtainable experimental results of similar work done for all kinds of channel cross sections. Detailed analysis and elaboration of experimental material mentioned above also made it possible to define with more precision the meaning of such concepts like flow development, transition regime, and non-isothermality influence in noncircular channels. (auth)

17186 HEAT TRANSFER TO LIQUID METALS FLOWING TURBULENTLY AND LONGITUDINALLY THROUGH CLOSELY SPACED ROD BUNDLES. PART I. Dwyer, O. E.; Berry, H. C. (Brookhaven National Lab., Upton, NY). Nucl. Eng. Des.; 23: No. 3, 273-294(1972).

Results are presented of a theoretical study of heat transfer to liquid metals in fully developed turbulent, in-line flow through unbaffled, spacer-free rod bundles. The bundles have equilateral triangular arrangement; and the rod spacings, rod design, and ranges of independent variables covered were chosen with reference to liquid-metal-cooled nuclear reactor applications. Three different sets of thermal boundary conditions are considered: uniform heat flux in the axial direction with uniform temperature in the circumferential direction, on the outer surface of the cladding; uniform heat flux in both directions, on the outer surface of the cladding; and uniform heat flux in both directions on the inner surface of the cladding. Rod-average heat-transfer coefficients and circumferential variations of temperature and heat flux on the rod surface are presented as functions of P/D and $\bar{\psi}$Pe. Five different methods of estimating the eddy diffusivity of momentum in the circumferential direction are employed, and the results compared. The reference method, which appears to be quite satisfactory, assumes the equality of the eddy diffusivities of momentum in both the circumferential and radial directions. The results, presented in both tabular and graphical forms, are reported in terms of convenient dimensionless groups, correlated by semi-empirical equations, and compared with previous results. (auth)

17187 DETERMINING THE TURBULENT EXCHANGE COEFFICIENTS IN TUBE BUNDLES SWEPT BY TRANSVERSE FLOW. Guelich, J. (Winterthur Engineering Works Div., Switzerland). Sulzer Tech. Rev.; No. 1972, 81-88(1972).

The turbulent exchange coefficients in the range $7 \times 10^3 < Re < 1.5 \times 10^5$ were determined on an in-line tube bundle under transverse flow with concentration measurements. The results are presented in the form of a Pe number whose upper limit can be reproduced by the correlation $Pe = 12{,}600 \cdot Re^{-0.71}$ with an uncertainty of about 20 to 30%. In the range $1.5 \times 10^4 < Re < 10^5$, irregularities were observed in the bundle flow, manifesting themselves in the form of marked variations in concentration, better mixing and a rise in the pressure loss coefficient. Together with the theory stated, the results provide the basis for predicting the temperature profiles normal to the direction of flow which establish themselves in cross-flow heat exchangers as a result of disturbances. (auth)

17188 INVESTIGATION OF HEAT TRANSFER INTENSIFICATION DURING LENGTHWISE FLOW ALONG TUBE BUNDLES WITH VARIOUS RELATIVE PITCHES. Kalinin, E. K.; Dreitser, G. A.; Kozlov, A. K. (Moscow Aviation Inst.). Int. Chem. Eng.; 13: No. 1, 1-4(Jan 1973).

Results of a study of the intensification of heat transfer by means of annular grooves with the longitudinal flow of water in a staggered tube bundle with S/D = 1.16, 1.2, 1.34, 1.4, and 1.5 are presented. (auth)

17189 EFFECT OF NONISOTHERMICITY ON STABILITY OF FREE-FALLING WATER FILMS. Dubrovskii, G. P.; Didenko, A. Ya.; Kokorev, L. S. This paper was summarized in At. Energ. (USSR); 31: No. 6, 621(Dec 1971) as paper No. 545/6298. (In Russian).

Full copy of this paper is held by TIC.

Results of an experimental investigation of the range of stable existence of a film falling freely over the outer surface of an electrically heated cylindrical rod are reported. (TFD)

17190 AXIALLY VARYING HEAT FLUX EFFECTS IN TUBES, FLAT DUCTS, AND WIDELY SPACED ROD BUNDLES COOLED BY A TURBULENT FLOW OF LIQUID METAL. Nijsing, R. (EURATOM, Ispra, Italy). Nucl. Eng. Des.; 23: No. 3, 331-346 (1972).

Accurate theoretical results are presented on temperature distributions and heat transfer coefficients for steady turbulent flow of a liquid metal in channels with an arbitrary prescribed wall heat flux in the flow direction. The geometries considered are the circular tube, the infinite flat duct and the widely spaced rod bundle. A new mathematical method of solution is given which lies midway between the purely numerical and analytical methods. (auth)

17191 HEAT TRANSFER TO LIQUID METALS FLOWING TURBULENTLY AND LONGITUDINALLY THROUGH CLOSELY SPACED ROD BUNDLES. Part II. Uniform Heat Flux at the Inner Surface of the Cladding. Dwyer, O. E.; Berry, H. C.; Hlavac, P. J. (Brookhaven National Lab., Upton, NY). Nucl. Eng. Des.; 23: No. 3, 295-308(1972).

Results are presented of an analytical study of liquid metal heat transfer in fully-developed, turbulent in-line flow through unbaffled, spacer-free rod bundles. The grid is equilateral triangular, and the boundary condition is uniform heat flux at the inner surface of the cladding. Results are compared with recent experimental results on mercury. (auth)

17192 STUDY OF HEAT TRANSFER IN BOILING TWO-PHASE CHANNEL FLOW. PART II. Heat Transfer in the Nucleate Boiling Region. Sato, T. (Kyoto Univ.); Minamiyama, T.; Yanai, M.; Tokura, T.; Ito, Y. Heat Transfer—Jap. Res.; 1: No. 4, 15-30 (1972).

Results of previous study on flow patterns in boiling two-phase flow are extended to analyze and correlate nucleate boiling heat transfer data. Coincidence of results between flow patterns and heat transfer has been found. Void fraction and transitional effects are discussed. An equation is presented for use over a wide range of conditions. Existing literature is compared in the analysis. (auth)

17193 STUDY OF HEAT TRANSFER IN BOILING TWO-PHASE CHANNEL FLOW. PART I. Flow Patterns in a Boiling Channel. Sato, T. (Kyoto Univ.); Minamiyama, T.; Yanai, M.; Tokura, T. Heat Transfer—Jap. Res.; 1: No. 4, 1-14(1972).

In order to clarify the phenomena of heat transfer in saturated boiling of a fluid flowing in a channel, it is necessary to clarify the flow conditions or flow patterns of the heated two-phase fluid. This paper summarizes the results of experiments concerning the flow patterns. Local flow patterns were investigated and observed along the entire length of test channels, and classified into bubble, slug, slug-annular, annular and bubbly-annular flows. The transitional conditions of the flow patterns and the effective factors, namely, heat flux, inlet conditions, heated length, diameter of channel and so on, on the transition are discussed. (auth)

17194 TRANSIENT HEAT TRANSFER THROUGH Á THIN-WALLED CIRCULAR PIPE. Forghieri, R.; Papa, G. (Comitato Nazionale Energia Nucleare, Bologna). Nucl. Eng. Des.; 23: No. 2, 147-154(1972).

The dynamic response of tubular heat exchangers to inlet fluid temperature variations is analyzed. A solution similar to that of Hayasi and Inouye is obtained by a different mathematical procedure. Finite integral transforms are used, and the kernel

is constructed in accordance with the geometry and boundary conditions. (auth)

17195 LIQUID-METAL COOLING SYSTEMS FOR HIGH TEMPERATURES. Rajakovics, G.; Gabernig, H.; Hanisch, H. Berg-Huettenmaenn. Monatsh.; 116: No. 3, 98-100(Mar 1971). (In German).

Developments in nuclear technology involving liquid-metal cooling systems, present trends in such systems, the materials used, and the fields of application of such systems are discussed in the light of practical examples, e.g., an evaporator for radioactive waste water and a Na circuit, both used at the Seibersdorf Reactor Center, and a valve for liquid Na up to 950°C. (Metals Abstr)

17196 PROCEEDINGS OF THE 1972 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE HELD AT NORTHRIDGE, CALIFORNIA, JUNE 14–16, 1972. Landis, R. B.; Hordemann, G. J. (eds.). Stanford, CA; Stanford University Press (1972). 441p. (CONF-720666–). $17.50.

From 23rd Meeting of the Heat Transfer and Fluid Mechanics Institute; Northridge, California, United States of America (USA) (14 Jun 1972).

Twenty-five papers on experimental and theoretical studies of heat transfer, mass transfer, and fluid mechanics were presented at the conference. A separate abstract was prepared for one paper. The remaining 24 papers are not within the scope of NSA. (LCL)

For an abstract of an individual paper see: 17197.

17197 THEORETICAL AND EXPERIMENTAL STUDY OF LAMINAR SPIRAL FLOW IN A POROUS PIPE. Bundy, R. D. (Oak Ridge National Lab., TN); Weissberg, H. L. pp 54-70 of Proceedings of the 1972 Heat Transfer and Fluid Mechanics Institute. Landis, R. B. (ed.). Stanford, CA; Stanford University Press (1972).

From 23rd Meeting of the Heat Transfer and Fluid Mechanics Institute; Northridge, California, United States of America (USA) (14 Jun 1972). See CONF 720666--.

Laminar spiral flow in a stationary porous pipe was studied theoretically and experimentally to investigate whether existing similarity solutions can be interpreted as fully developed spiral flows which can be obtained from entrance-region calculations as far-downstream solutions and whether such flows can be achieved experimentally. The results are compared with those for non-swirling flow. Numerical similarity solutions to the ordinary differential equations describing fully developed spiral flow in a porous pipe were obtained using a predictor-corrector integration technique to extend the range for which such solutions are available. Spiral flow in the entrance region of a porous pipe was studied using a finite-difference marching technique valid for high ratios of axial to wall velocities. Swirling flows of air were studied experimentally in a 1.379 in. ID porous titanium tube. Mildly fluctuating wall pressure differences having mean values quite similar to those of the theoretical fully developed spiral flow were observed at approximately the same wall suction rates for which the finite-difference entrance-region calculations with fully developed inlet flows were stable. (auth)

17198 REVIEW OF PHYSICAL MODELS AND HEAT-TRANSFER CORRELATIONS FOR FREE-CONVECTION FILM BOILING. Bressler, R. G. (Univ. of Tennessee, Knoxville). Advan. Cryog. Eng.; 17: 382-406(1972).

Film boiling as a cooling process has found more commercial uses in recent years due to technological advances in such areas as nuclear reactors, rocketry, and cryogenics. With the development of high-temperature-strength materials, film boiling will be attractive for other applications also. The first film boiling data were obtained by metallurgists in quenching studies. Subsequent studies of film boiling on horizontal cylinders and vertical surfaces and the physical models developed for theoretical studies are discussed. Several heat transfer correlations for free convection film boiling are explained as to theoretical derivation and are compared with each other and with empirical data. From this comparison, specific heat transfer correlations for horizontal plates, vertical plates with laminar flow, and horizontal cylinders are recommended for design purposes. (LCL)

Materials Testing

Refer also to abstracts 17435, 17470, and 19347.

17199 COMPUTERS AND THE ANALYSIS OF PRESSURE VESSELS. Kraus, H. (Rensselaer Polytechnic Inst., East Windsor Hill, CT). Comput. Struct.; 2: No. 5-6, 757-769(Dec 1972).

The history of the application of the digital computer to the analysis of stresses in modern pressure vessels is traced. Several analytical and non-analytical problems which the extensive use of the digital computer has precipitated are also discussed. The main analytical problems concern, in addition to questions of memory size, running time, etc., the fact that computing power is now far ahead of an understanding of the behavior of the materials of construction. The main non-analytical problems concern the verification of the validity of programs and the qualifications of their users. Others involve the certification of programs by neutral parties, the creation of program libraries and access to computers and programs by small manufacturers. Finally, questions are discussed regarding the educational background that is required to prepare for work in a modern, highly computerized pressure vessel design office as well as the types of careers that one can pursue in such an environment. (auth)

17200 USE OF RADIOGRAPHS IN A GEOLOGICAL AND GEOTECHNICAL INVESTIGATION OF VARVED SOIL. Kenney, T. C.; Chan, H. T. (Univ. of Toronto). Can. Geotech. J.; 9: No. 2, 195-205(May 1972).

Several uses of radiographs of soil samples valuable in a geological and geotechnical investigation of varved soil are described. The radiographs were taken while the soil was still in the sampling tubes, thus enabling examinations to be made of the samples before they were extruded. The radiographs were primarily used to record in detail the soil stratigraphy, to make examinations of the soil structure and texture, and to help plan laboratory-test programs. Damage to "undisturbed" samples, in the form of transverse cracks created during the sampling process, was detected by examination of the radiographs. Such features as these might not be detected in extruded samples because they are obscured by smeared soil on the surface of the sample and because cracks would tend to become closed during extrusion. A brief discussion is included of the requirements for making radiographs. (auth)

17201 APPROXIMATE CALCULATION TECHNIQUES FOR THE DESIGN OF GEOMETRIES SPECIFIC TO INDUSTRIAL APPLICATIONS ON THE BASIS OF GAMMA-RADIATION SCATTERING. Marghitu, V. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 7, 879-898(1972). (In Rumanian).

After a brief introduction, some practical aspects of the problem are explained. The qualitative analysis of gamma radiation transport is discussed. The transport equation, diffusion approximation, build-up approximation, and similitude approximation are considered. Experimental agreement of the theoretical results is examined. The determination of diffusion parameters and some particular values for common radioisotopes are given in an appendix. (8 figures, 2 tables) (RWR)

17202 QUALITY ASSURANCE IN ATOMIC ENERGY INDUSTRY. Miyoshi, S.; Fukushima, H. (Fuji Electric Co. Ltd., Tokyo). Fuji Jiho; 45: No. 8, 703-707(Aug 1972). (In Japanese).

Quality assurance in materials, components, equipment, etc., is being emphasized increasingly at present with the practical utilization of atomic energy, especially in nuclear power generation. This is because of the severe consequence of accidents and difficulties in repair after the initiation of operation. The ideas and practices of quality assurance and control in this field are described on the basis of data and information from the U. S. AEC and ASME as follows: general aspects of quality assurance; organization for carrying out quality assurance; management of design, documentation, purchasing, materials, components, and machinery and equipment, special processes and treatments, testing and inspection, measuring instruments, transport, storage, and packing, testing, rejected goods, and records of quality-assurance data; supervision of the quality-assurance practice, and schemes for attaining the quality assurance. (JA)

17203 INSPECTION OF CRITICAL SAFETY ITEMS WITH HIGH SPEED EDDY CURRENT TEST METHODS. Sailer, W. (Automation Industries, Inc., Danbury, CT). Test. Instrum. Contr.; 9: No. 10, 7-15(Oct 1972)

The steel, nuclear reactor, and transportation industries have been concerned for many years with methods to improve the quality of finished and semi-finished parts. With tighter restrictions in quality acceptance standards being imposed on the industry, only high speed automatic test and sorting systems can meet these increased demands while maintaining costs at competitive levels. Some of the high-speed eddy current NDT systems which have been built for the inspection of critical safety items are discussed. (auth)

17204 LUMPED FINITE ELEMENT BASES FOR BEAMS AND PLATES. Kikuchi, F.; Ando, Y. (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 12, 749-51(Dec 1972).

Finite element bases for bending analysis of beams and plates are proposed, accompanied by some numerical experiments conducted for vibration and dynamic stability problems. (TFD)

17205 X-RAY DETERMINATION OF RESIDUAL STRESS. Norton, J. T. (Advanced Metals Research Corp., Burlington, MA). Mater. Eval.; 31: No. 2, 21A-24A, 37A-41A(Feb 1973).

The basic principles of the x-ray method of measuring residual stress in metals are reviewed. The nondestructive character of the method and its ability to make measurements on small surface areas are its unique features. Experimental techniques using both the diffractometer and film recording are discussed and examples of application are given. New developments involving automation of the procedures are described. Consideration of the results of x-ray and mechanical methods points out the important role of the elastic constant of the material, and values obtained by x-ray and mechanical methods are compared. The applicability of the method for a variety of practical problems is discussed, and it is concluded that despite the limited understanding of the elastic and plastic behavior of polycrystalline metals, the x-ray method provides a powerful and reliable tool for the investigation of residual stresses. (auth)

17206 EFFECT OF TRANSVERSE SHEAR ON LIMIT LOAD OF CYLINDRICAL SHELLS. Haydl, H. M.; Sherbourne, A. N. (Univ. of Waterloo, Ont.). Nucl. Eng. Des.; 22: No. 2, 290-5 (1972).

The effect of transverse shear on the collapse load of clamped externally pressurized cylindrical shells was investigated. The shell material is assumed rigid-plastic and obeys the von Mises flow condition. Exact numerical solutions are obtained for limit loads with and without consideration of transverse shear. Results are shown in graphs and it is concluded that the presence of transverse shear in the yield condition leads to significant reductions of the limit load for some shell geometries. (auth)

17207 METHOD OF COMPUTING STRESS RANGE AND FATIGUE DAMAGE IN A NUCLEAR PIPING SYSTEM. Wright, W. B. (Westinghouse Electric Corp., Pittsburgh); Rodabaugh, E. C. Nucl. Eng. Des.; 22: No. 2, 318-25(1972).

The ASME Boiler and Pressure Vessel Code, Section III (1971) employs stress range and fatigue evaluation as part of the total stress evaluation of piping systems. One method of computing this stress range and the resultant fatigue damage using the basic equations of the Code is presented here. This method is then illustrated by examples and discussed in detail. (auth)

17208 FINITE ELEMENT SOLUTIONS FOR PLATE BENDING PROBLEMS BY SIMPLIFIED HYBRID DISPLACEMENT METHOD. Kikuchi, F.; Ando, Y. (Tokyo Univ.). Nucl. Eng. Des.; 15: No. 2, 155-178(1972).

The formulation of the simplified hybrid displacement method for plate bending is given systematically with some extension made to allow for the discontinuity of deflection field. Eight types of finite elements are developed utilizing this principle. They are tested numerically with static, vibration, and stability problems of thin elastic plates. The results obtained are in general satisfactory, thus ensuring the feasibility of the method. (auth)

Nuclear Explosions

Refer also to abstracts 17250, 17252, 17253, 17260, and 17275.

17209 (AWRE-O-49/72) SOME SEISMIC RESULTS FROM A WORLD WIDE SAMPLE OF LARGE UNDERGROUND EXPLOSIONS. Marshall, P.D. (Atomic Weapons Research Establishment, Aldermaston, England). Oct 1972. 100p. Dep. NTIS. (U.S. Sales Only). UK 2.00 pound.

Short-period seismic array data, together with long-period data from standard stations, were analyzed to provide estimates of the location and yield of explosions in China, North Africa, the Soviet Union, and the USA. (auth)

17210 (NVO-86(Rev. 2)) REPORTS AVAILABLE IN PLOWSHARE OPEN FILE. (Nevada Operations Office (AEC), Las Vegas). Jan 1973. 36p. Dep. NTIS.

Those publications concerning Gasbuggy, Rulison, Rio Blanco and Wagon Wheel Events in the Plowshare Project, that have been placed in the Plowshare Open Files by the Nevada Operations Office are listed. All of these publications are available to the scientific, technical, and industrial communities. Also listed are certain other publications concerning the AEC's safety programs for underground nuclear detonations which may be of particular interest. (auth)

17211 (NVO-746-2) L-7 VELOCITY SEISMOGRAPH SHAKING-TABLE RESULTS. Navarro, R.; Wuollet, G. M. (National Oceanic and Atmospheric Administration, Las Vegas, Nev. Earth Sciences Labs). Jul 1972. Contract AT(29-2)-746. 50p. (NOAA-TR-ERL-254-ESL-26). GPO.

The Model L-7 velocity seismograph is used extensively by the Earth Sciences Laboratories, Nevada Special Projects Party, to collect ground motion data from both nuclear events and earthquakes. The L-7 systems were subjected to a series of tests using shaking tables to simulate ground motion inputs. The tests were performed to provide inter-unit data to substantiate that each system was within quoted accuracy limits and identical to the next. A total of 210 seismometers were tested which comprised a combination of vertical and horizontal seismometers. The results of the tests indicated that the L-7 systems are within accuracy limits required for the Atomic Energy Commission's ground motion and structural response program. (auth)

17212 (NVO-746-TM-5) REFRACTION SURVEYS AT THE SHELL OIL COMPANY'S OIL SHALE PROJECT: PICEANCE CREEK BASIN, COLORADO. Bayer, K. C.; Navarro, R. (National Oceanic and Atmospheric Administration, Las Vegas, Nev. Earth Sciences Labs). Jul 1972. Contract AT(29-2)-746. 19p. (NOAA-TM-ERL-ESL-20). Dep. NTIS.

A refraction survey was made at the Shell Oil Company's oil shale project located 28.5 miles southeast of Rangely, Colorado. The thickness of the alluvium layer at the site ranged from 6 ft to 24 ft, with an average depth of 18 ft. The average propagational velocities of the low and high velocity layers were 1140 ft/sec (V_1) and 4640 ft/sec (V_2) respectively. The apparent dip of the V_1-V_2 and V_2-V_3 interfaces was less than 5 degrees in every instance. (auth)

17213 (NVO-1253-1) EVENT-RELATED HYDROLOGY AND RADIONUCLIDE TRANSPORT AT THE CANNIKIN SITE, AMCHITKA ISLAND, ALASKA. Fenske, P. R. (Nevada Univ., Reno. Desert Research Inst.). May 1972. Contract AT(29-2)-1253. 44p. Dep. NTIS.

The hydrologic system at the Cannikin site consists of a dynamic fresh-water lens. The interface between this lens and the ocean is broadly dispersed, but has been identified by examining potential distribution, water analyses, and temperature profiles. At the Cannikin site, moving ground water will not occur much below 1120 meters below sea level, more than 500 meters above the detonation point. The potential drop in an extensive zone of low permeability between 197 and 368 meters below sea-level limits development of the fresh-water lens and ground-water movement below 368 meters below sea level. Transit time of water from rubble chimney to Bering Sea has been estimated from ^{14}C age dates, hydraulic conductivity, porosity, gradient, and expected infiltration rates to be in excess of 3000 years. In this period of time maximum conceivable concentration of tritium, the only radionuclide considered transportable, will be reduced to essentially zero. (auth)

17214 (UCRL-51293) EFFECTS OF HEAT AND RADIATION ON GASBUGGY CHIMNEY GAS. Bozak, R. E.; Taylor, R. W. (California Univ., Livermore. Lawrence Livermore Lab). 24 Oct 1972. Contract W-7405-Eng-48. 20p. Dep. NTIS.

Chemical changes in the gas in the Gasbuggy chimney were observed for about six months following the explosion. Heat and radiation are postulated to cause this change. Samples of gas taken from the chimney at one month were heated and irradiated in the laboratory. Heat produced a decrease in H_2 and an increase in CH_4 concentration—trends that were observed in the chimney. On the other hand, irradiated samples of this gas showed a dose-related increase in H_2 and decrease in CH_4. Irradiation also caused about one-third of each gas sample to change into an oil. (auth)

17215 (UCRL-51304) RIO BLANCO GAS QUALITY. Taylor, R. W. (California Univ., Livermore. Lawrence Livermore Lab). 19 Dec 1972. Contract W-7405-eng-48. 17p. Dep. NTIS.

Using two previous gas-stimulation experiments as a basis, the chemical composition and the concentration of radioactivity in the gas to be produced from the Rio Blanco chimney was predicted. A description of the changes to be expected in chemical composition, radioactivity, and steam content as a function of production rate is included. (auth)

17216 NEVADA UNDERGROUND NUCLEAR EXPLOSIONS RECORDED AT KASPERSKE HORY SEISMOLOGICAL STATION. Zahradnik, Jiri (Charles Univ., Prague). Stud. Geophys. Geod.; 16: No. 4, 367-372(1972).

Eighteen P-wave patterns of the Nevada underground nuclear explosions, recorded at Kasperske Hory (KHC), were analyzed. A very simple method, similar to the routine observation work, has been used to describe the P-wave train quantitatively. Certain relations between the descriptive quantities, that indicate similar features of the records under study, are found. (auth)

17217 PREVENTING AN ARMS RACE ON THE SEA-BED. pp 533-541 of World Armaments and Disarmament. Stockholm; Almqvist and Wiksell (1972).

The Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil Thereof which was commended by the UN General Assembly in a resolution of 7 December 1970 is discussed. By 1 January 1972 the treaty had not entered into force. This delay is analysed and the text of the treaty is appended. (SW)

17218 NUCLEAR TEST BAN DEBATE. pp 523-532 of World Armaments and Disarmament. Stockholm; Almqvist and Wiksell (1972).

The main topics discussed during 1970–71 at the United Nations and at the Conference of the Committee on Disarmament are reviewed. Verification systems and the peaceful applications of nuclear explosions are examined. The legal form of a test ban and a draft treaty are discussed. (SW)

17219 TREATY FOR THE PROHIBITION OF NUCLEAR WEAPONS IN LATIN AMERICA (TREATY OF TLATELOLCO). pp 542-549 of World Armaments and Disarmament. Stockholm; Almqvist and Wiksell (1972).

The application of the Treaty Tlatelolco prohibiting nuclear weapons in Latin America signed in 1967 is reviewed. It is stated that the goal set for coverage and ensured universal respect for the legal status of military denuclearization of the area is still far from being achieved. (SW)

17220 TEST BAN. pp 389-436 of World Armaments and Disarmament. Stockholm; Almqvist and Wiksell (1972).

Various issues involved in a comprehensive nuclear test ban (CTB), especially political and strategic aspects of a test ban, are analyzed. The history of the Partial Test Ban Treaty (PTB) and the U. S. and Soviet policies are surveyed. Frequency of testing, verification, military significance of tests, and nuclear explosions for peaceful purposes are discussed. Finally, the political significance of a comprehensive test ban is analyzed. (SW)

Protective Structures and Equipment

17221 (ORNL-tr-2656) CIVIL DEFENSE. Second Edition. Egerov, P. T.; Shlyakhov, I. A.; Alaben, N. I. Translated for Oak Ridge National Lab., Tenn., from Russian. 31p. Dep. NTIS.

The characteristics and objectives of nuclear missile warfare in the future, the surprise nuclear attack capabilities of the US and UK, and the importance of civil defense preparations for surviving such an attack are discussed. The goals of civil defense are enumerated as protection of the population, preservation of the civilian economy, and rescue and emergency rebuilding operations at destruction sites. USSR programs for organizing and carrying out civil defense services and the structure of civil defense units in populated and rural areas are described. (LCL)

17222 PRESSURE DROP OF A FIBROUS FILTER AT REDUCED AMBIENT PRESSURES. Robinson, M.; Franklin, H. (Atomic Energy Commission, New York). J. Aerosol Sci.; 3: No. 6, 413-427(Nov 1972).

A phenomenological description is presented of the relation between pressure drop, gas velocity and other gas and filter variables for a fibrous filter medium. Experimental and theoretical consideration extends to viscous and inertial flow, compressible and incompressible flow, and to conditions of slip and slip-free flow. Pressure drop Δp (N/m^2) is shown to be given closely by the relation $\Delta p = p_i C_i - [(p_i C_i)^2 - 2p_i L \nu_i (k_1\mu/\alpha + k_2\rho_i\nu_i/\beta)]^{\frac{1}{2}}$ where p_i (N/m^2) is the inlet pressure, C_i (dimensionless) is the inlet Cunningham correction (fiber diameter replacing the usual sphere diameter), L (m) is the filter mat thickness, ν_i (m/sec) is the inlet face velocity, μ (daP) is the gas viscosity, ρ_i (kg/m^3) is the gas density, and β/k_2 (m) and α/k_1 (m^2) are filter constants, the last being the specific permeability of Darcy's law. Experimental data obtained with Institute of Paper Chemistry 1478 filter paper over the ambient pressure range 0.0013 to 0.86 atm (corresponding to the range of Knudsen numbers 6 to 0.01) are in good agreement with the theory, which is presumably valid to much higher pressures. Methods are described for correlating experimental data in terms of dimensionless groups and, on the basis of relatively few measurements near atmospheric conditions, for estimating pressure drop over a broad range of ambient pressures and gas velocities. (auth)

17223 MAXIMUM WORKING TIME IN A CONTAMINATED AREA. Schaeffer, R.; Delpla, M. (Electricite de France; Paris). pp 127-38 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The case of personnel working without masks or independent breathing apparatus, or personnel having been forced to abandon such apparatus during operations in a contaminated area is considered. Two limits are fixed for the entire organism: 3 rem for normal operations; 12 rem for exceptional operations. The maximum working time is expressed as a function of the various types of hazard possible: internal contamination produced by inhaling irradiated or nonirradiated uranium; internal contamination with external contamination of the entire organism, with or without contamination of the skin or clothing. (France)

17224 EXPERIMENTAL STUDY OF DEFECTS IN A LEAD SHIELDING. Vertut, J.; Fourcade-Cancelle, N.; Papot, L.; Ribette, S. (CEN de Saclay, Gif-sur-Yvette, France). pp 165-94 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The homogeneity of a biological shielding is usually tested using a radioactive source and radiation detectors. The shape and size of the shielding defects were studied from measurements made with a portable ionization chamber. Radiation hazards for the operators were investigated and acceptance or rejection criteria for the shielding defects were established. (France)

17225 MONITORING OF FLOOR MOPS. SOME EXPERIENCES. Carlsson, G. S.; Widell, C. O. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 517-21 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The monitoring of floor mops is a very convenient method for the control of contamination. The floor mops are monitored by a β-γ GM-probe, which is placed in the center of a bag of floor mops. This method gives satisfactory results for most β-γ contamination. Some experiences from 6 years routine use of this method are discussed. (France)

17226 NEW SHIELDING BRICKS FOR NEUTRON AND GAMMA RAY SHIELDING. Busta, Jiri (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 19: No. 1, 25-27(Jan 1973).

A new shape of shielding bricks (covered by a Czechoslovakian patent) makes it possible to assemble rearrangeable mechanically strong walls, ceilings, and floors of the most varied forms. The rectangular wall connection is simple and its strength is excellent; the shielding so assembled is compact and it cannot be destroyed by an accidental impact. By using the special brick shape it is possible to use a technology which permits an essential reduction of cost in comparison with commonly used prismas or thick-walled plates. (auth)

Safety Engineering

17227 (ORNL-TM-4046) EVALUATION AND PROCUREMENT GUIDE FOR THREE TYPES OF METALLIC RUPTURE DISK ASSEMBLIES. (Oak Ridge National Lab., TN). Jan 1973. Contract W-7405-eng-26. 75p. Dep. NTIS.

The conventional pre-bulged, reverse-buckling, and snap-over rupture disk units are three commonly used types of rupture assemblies with metallic disks. The characteristics of these types of assemblies are reviewed, and factors to be considered in their selection for a particular application are discussed. Procedures for evaluating the burst pressure and fatigue life of each type of assembly are presented. Pertinent ordering and installation data are also discussed. (auth)

17228 FIRST RESULTS OF THE CONTROL OF MEDICAL RADIOGRAPHY INSTALLATIONS FOR APPROVAL BY THE MINISTRY OF PUBLIC HEALTH. Delhove, J. (Controlatom a.s.b.l., Brussels). J. Belge Radiol.; 55: No. 2, 285-292(1972). (In French).

All medical radiological equipment is to be of a type approved by the Ministry of Public Health, in accordance with the provisions of the Royal Decree of Dec.23, 1970. For equipment already in service, the approved authority assigned with the physical inspection of the premises concerned has to issue a report on the working conditions of the apparatus itself and the means of protection being used. Inspections carried out between Feb. 18,and Sept. 30, 1971 covered 1563 medical radiological tubes. 1128 final reports were issued and 435 provisional reports. Generally speaking, it was found that the technical characteristics of the equipment were not well known, the personnel were not sufficiently well informed and that additional means of protection for the patient were lacking. For the inspection of dental radiographic equipment, an additional test was carried out. More than a quarter of the effective

beams in use were appreciably wider than the standard. The doses in the effective beam varied from 60 MR up to more than 10,000 MR. In 80% of the cases investigated, the dose was less than 1000 MR. In 44 cases, the dose was between 1000 and 2500 MR. Finally, in 16 cases, the dose exceeded 2500 MR. The highest doses were found where radiation was insufficiently filtered. In conclusion, the first results show that more than $^3/_4$ of the apparatus in use are already satisfactory. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

17229 INDICATORS OF ENVIRONMENTAL QUALITY. Proceedings of a Symposium Held During the AAAS Meeting in Philadelphia, Pennsylvania, December 26–31, 1971. Thomas, W. A. (ed.). Environmental Science Research, Volume 1. New York; Plenum Publishing Corporation (1972). 283p. $18.50. (CONF-711222).

Separate abstracts were prepared for two of the 21 papers presented. The other papers discuss: uses of environmental indices in policy formulation; urban-environmental indicators in municipal and neighborhood policy planning and decision making; the obligation of scientists to explain environment to the public; evaluation of natural environments; indicators of environmental quality of urban life; pollutant burdens in humans as measures of environmental quality; aquatic communities as indices of pollution; plants as indicators of air quality; biochemical indicators of environmental pollution; use of sense of smell in determining environmental quality; development of environmental indices–outdoor recreational resources and land use shifts; a water quality index; indices of air quality; statistically based air-quality indices; indicators of environmental noise; developing a soil quality index; and plant indicators in ecology. (ERB)

For abstracts of individual papers see: 17238 and 17590.

Minerals and Ores

17230 (BARC/I-162) ACTIVITY BUILDUP OF NATURALLY OCCURRING RADIOACTIVE MATERIALS. PART I. Gopinath, D.V.; Singh, H. (Bhabha Atomic Research Centre, Bombay, India). 1972. 50p. Dep. NTIS (U.S. Sales Only).

The radioactivity of materials like natural uranium and natural thorium will vary rapidly with time owing to the build-up of their long chain of daughters. Calculated data are presented on individual daughter activity, total alpha, beta, and gamma activity, and energy build-up with time in natural uranium, natural thorium, radium, and radon. Based on these calculated values, salient features in the radiometric behavior of each of the groups are discussed. Isotopic composition and the activity build-up of the thorium obtained from the monazite sands of Travancore are also discussed. (auth)

17231 RADIOMETRIC METHODS FOR MAPPING DISCONTINUOUS STRUCTURES AND PROSPECTING FOR RARE METAL ORES. Kotel'nikov, G. N.; Grigor'ev, V. V. At. Energ. (USSR); 33: No. 6, 989-990(Dec 1972). (In Russian).

The scintillation radiometer SRP-2 was employed in a search for sharp changes in the γ-activity of rocks whereby a number of petrographic differences could be distinguished. A detailed geologic-radiometric mapping of Dicke zones and meridional fractures lead to the discovery of some sections with complex ores of U, Th, Li, Zr, Nb, and Ta. Typical mapping over a 500-meter segment of land (5 to 60 μCi/hr) included rock identifications such as biotite granite, reibeckite granite, and the vein types: Dicke Diabase, diffuse zones of mylonitization, and certain established and conjectured granites. (KSW)

17232 SHARP ADVANCE PROJECTED FOR MINING INVESTMENT. Eng. Mining J.; 174: No. 1, 61-75(Jan 1973).

Projected investments on materials including W, U, V, and Mo by nonferrous mining firms are tabulated. (TFD)

17233 CERTAIN FEATURES OF THE RELATION OF HYDROTHERMAL URANIUM–MOLYBDENUM ORES TO ROCKS OF VOLCANIC ORIGIN. Konstantinov, V. M.; Yakunin, D. I. At. Energ. (USSR); 34: No. 1, 3-5(Jan 1973). (In Russian).

Data are presented on certain features of geological development of two regions characterized by the presence of uranium-molybdenum ore formations. In the first region, magmatic activity concludes with the formation of volcanic apparatus, with which uranium ores are connected spatially and genetically. In the second region, after volcanic activity there are formed granitoid intrusions, and only then uranium-molybdenum ores. In this region, the spatial inclination of uranium-molybdenum ores to the volcanic apparatus is considered as a particular case of structure control. (auth)

17234 NEW SPECIES OF MINERAL: META-LODEVITE (HYDRATED ARSENATE OF URANIUM AND ZINC). Agrinier, H. (CEN, Fontenay-aux-Roses, France); Chantret, F.; Geffroy, J.; (and others). Bull. Soc. Fr. Miner. Crist.; 95: No. 3, 360-364(May 1972). (In French).

This mineral given the name meta-lodevite [$Zn(UO_2)_2(AsO_4)_2$ $8\text{-}12H_2O$] was discovered in the permian basin of the Lodeve (Herault). The crystals found are tabular flattened along the c axis, belong to the quadratic system, and have the following parameters: a = b = 7.16A; c = 17.20A. They belong to the $P4_2/m$ space group and have a calculated specific gravity of 4.00. The mineral has anomalous optical properties. It is composed of negative biaxial crystals with 2V varying between 27 and 37 degrees for the Na D line. The refractive indices were found to be n(g) = 1.635 → 1.640 ± 0.002, n(m) = 1.635 ± 0.002, and n(b) = 1.615 ± 0.005. The mineral possesses the following chemical composition: UO_2: 54.44%; As_2O_5: 20.64%; ZnO: 6.47%; H_2O: 17.06%. (France)

17235 MINERALOGIYA. (Mineralogy). Korzhinskii, D. S. (ed.). International Geological Congress, XXIV Session, Reports of Soviet Geologists, Problem 14. Moscow; Izdatel'stvo Nauka (1972). 84p.

This volume includes reports on the mineralogy and petrography of alkaline rock formations and on the thermochemistry of ore minerals. The most general problems of alkaline rocks petrology, such as: history of alkaline magmatism development on the platforms and on the areas of completed folding, influence of the geological environment on the formation of different types of alkaline rocks, role of the contact reaction and postmagmatic processes, and variation of the alkalinity regime through the successive phases of the alkaline magmatic activity are discussed. The petrology and geochemistry of ultrabasic-alkaline rocks and carbonatites of definite regions are elucidated as well as mineralogy of alkaline massifs. The results of original experiments with the systems containing rare but practically important minerals are presented and analysed in the reports of the second group. These are systems of borates and borosilicates, rare earth minerals and silphosalts. (auth)

17236 MATRIX DETERMINATION OF PARAMETERS IN URANIUM–LEAD AND URANIUM–THORIUM–LEAD ISOCHRONES. Levchenkov, O. A. (Inst. of Geology and Precambrian Geochronology, Leningrad). Dokl. Akad. Nauk SSSR; 205: No. 5, 1201-3 (1972). (In Russian).

The geochronological estimates of ages of U–Th–Pb mineral systems are usually made by methods that provide for the construction of isochrones on graphs of the ratios $^{206}Pb/^{238}U - ^{207}Pb/^{235}U$ and $^{208}Pb/^{232}Th - ^{207}Pb/^{235}U$, after introducing the customary corrections. A matrix was constructed from the equations for such calculations and used in a couple of sample age calculations. (KSW).

Radioactive Effluents

Refer also to abstracts 17022, 17244, 17946, 19124, 19154, 19156, 19158, 19195, 19217, and 19224.

17237 (SZS-142, pp 29-32) ON THE DETERMINATION OF THE PERMISSIBLE RELEASE OF RADIOACTIVE MATERIALS INTO THE ATMOSPHERE VIA THE EXHAUST AIR OF NUCLEAR POWER PLANTS. Zindler, H. Sep 1972. (In German).

The determination of the permissible releases of radioactive materials from nuclear power plants into the atmosphere should be based on a site-specific exposure model. This model permits the calculation of the permissible releases starting from the maximum permissible exposure of individuals or large groups of the population and considering the conditions of dispersion in the atmosphere, the accumulation and discrimination processes in the ecosystem as well as the utilization of the environment. The first part of such an exposure model, calculation of dispersion and dilution of radioactive materials in the atmosphere, has just been finished. Further steps are discussed. (auth)

17238 ESTABLISHING PRIORITIES AMONG ENVIRONMENTAL STRESSES. Reiquam, H. (Battelle Memorial Inst., Columbus, OH). pp 71–82 of Indicators of Environmental Quality. Thomas, W. A. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on Indicators of Environmental Quality; Philadelphia, Pennsylvania, United States of America (USA) (26 Dec 1971). See CONF-711222–.

Using fallout from the use of nuclear weapons as a benchmark, nineteen environmental stresses are ranked in descending orders of present and projected priority. The ordering is intended to help identify and put into perspective those problems with the widest and most complex implications or manifestations. Complexity is determined on the basis of range, persistence, and

system complexity where the systems considered are biological, social, and political. (ERB)

17239 DISCHARGE OF NOBLE GASES FROM NUCLEAR PLANTS: OPERATION OF CHARCOAL FILTERS. Curzio, G. (Univ., Pisa, Italy); Gentili, A. pp 233-44 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The number of nuclear plants existing is such that serious environmental problems can arise from radioactive discharges. Inert gases are treated, mostly, by filtration with charcoal beds. In this way, the gases can be concentrated into small volumes, thereby facilitating storage. Some causes of filter failure are examined: geometrical considerations; average size of the charcoal granules; and humidity of the transport gas. The experimental results are presented and the direction in which the research is to proceed is discussed. (France)

17240 PREDICTION OF ENVIRONMENTAL RELEASES FROM NUCLEAR REACTORS UNDER NORMAL AND ACCIDENT CONDITIONS. Macdonald, H. F.; Clarke, R. H. (Central Electricity Generating Board, Berkeley, Eng.). pp 817-30 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Examples are given of the application of the EERIE code to the study of operational and accidental releases from a range of reactor types. Theoretical estimates are made of the total β count rates and γ^{+} spectra, which would be obtained from air samples taken downwind of the reactor during the various releases. The comprehensive nature of the calculations, which enables the complete history of the isotopic content of the defective fuel to be followed continuously from the initial release from the fuel through its dispersion in the atmosphere, makes it possible to identify critical parameters and potential problems. For example, interference in the measurement of small quantities of highly toxic nuclides due to larger amounts of short-lived or relatively low radiotoxic isotopes can be studied. For routine reactor discharges the results may be used in the planning of environmental surveys and in siting studies involving the estimation of doses to exposed populations. In the context of accident situations the calculations provide data that assist in the organisation of emergency sampling and monitoring procedures. (France)

17241 CONTROL OF RADIOACTIVE POLLUTION AROUND THE MARCOULE CENTER. Marichal, M. (Centre de Marcoule, Bagnols-sur-Ceze, France). pp 853-70 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The effect on the environment of radioactive liquid and gaseous wastes discharged from the Marcoule Center is monitored by examining samples of flora and fauna, and in addition the water table and the sediments of the river Rhone. The results obtained over the last 12 yrs are examined. The increase in the level of the radioactivity discharged is mainly due to the dispersion of liquid effluents. The fixation of different nuclei in relation to the nature of the sample taken is analyzed. (France)

Radioactivity Monitoring and Transport

Refer also to abstracts 17238, 17241, 17576, 17590, 17602, 17684, and 17946.

17242 (EUR-4897) APPLICATIONS OF A DERIVED FORMULA FOR THE DISCHARGE OF RADIOACTIVE LIQUID WASTES. Branca, G.; Breuer, F.; Cigna, A. A.; Amavis, R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy); European Communities, Luxembourg. Commission). Jan. 1973. 36p. Dep. NTIS (U.S. Sales Only). EUR B. Fr. 60.-.

The discharge of radioactive waste in the environment is a source of environmental pollution. For public health protection, it is essential to know the behaviour of each radionuclide in different media. This behaviour can be evaluated by a previsional mathematical model, such as has been developed in a former publication (EUR 4636e). Some examples of application of this developed model are given for the following practical problems: discharge into a watercourse used for drinking purposes; discharge into a watercourse used for irrigation; discharge into a lake used for fishing and the supply of drinking water; discharge from different nuclear installations into the same hydrological system; discharge of gaseous wastes into the atmosphere. An application of this model is also proposed to nonradioactive pollution problems. (auth)

17243 (NRL-F-49) FALLOUT FROM NUCLEAR WEAPONS TESTS CONDUCTED BY FRANCE IN THE SOUTH PACIFIC DURING JUNE AND JULY 1972 AND COMPARISONS WITH PREVIOUS TEST SERIES. (National Radiation Lab., Christchurch (New Zealand)). Oct 1972. 22p. Dep. NTIS (U. S. Sales Only).

Data are reported on the total β activity in atmospheric samples, the total γ activity in precipitation samples, and the content of ^{131}I in milk samples collected from various locations in New Zealand. (CH)

17244 (ORP/SID-72-2) ENVIRONMENTAL RADIOACTIVITY SURVEILLANCE GUIDE. (Office of Radiation Programs, Washington, D. C. Surveillance and Inspection Div.). Jun 1972. 31p.

Methods are recommended for conducting a minimum level of environmental radiation surveillance outside the plant site boundary of light-water-cooled nuclear power facilities. An environmental surveillance program is presented to achieve uniformity so that the data will be compatible and subject to singular interpretation relative to the estimated population radiation dose. The basic concepts presented may also apply to surveillance around other nuclear facilities such as gas-cooled and liquid-metal-cooled nuclear power facilities and nuclear fuel reprocessing plants. However, as additional nuclear facilities of these types are licensed and operated, additional guides may be needed. Procedures are recommended but requirements are not established for any particular organization for conducting environmental surveillance. Environmental radiation surveillance programs conducted around nuclear power facilities should as a minimum provide data that may be used: for population dose calculations, which can be compared with Federal and State standards; for evaluation of buildup of environmental radioactivity; and for public information purposes. (auth)

17245 (WASH-1527(Dr.)) TRANSURANIUM SOLID WASTE DEVELOPMENT FACILITY, LOS ALAMOS SCIENTIFIC LABORATORY, NEW MEXICO. Draft environmental statement. (Atomic Energy Commission, Washington, D. C.). Dec 1972. 45p. Dep. NTIS.

The environmental impact of constructing and operating a Transuranium Solid Waste Development Facility at the Los Alamos Scientific Laboratory in New Mexico is estimated. The proposed project involves constructing a building with equipment for demonstrating solid waste volume reducing processes such as crushing, sorting, compacting, and incineration. Land damage due to construction activities, radioactivity releases from normal operation and during an adverse accident such as a fire, and the eventual decontamination and removal of the building are considered. In assessing and balancing the anticipated benefits against the environmental and economic costs of the proposed facility, it was concluded that the proposed solid radioactive waste volume reduction facility should be designed and constructed. (LCL)

17246 (WASH-1528(Dr.)) FUTURE HIGH LEVEL WASTE FACILITIES, SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA. Draft environmental statement. (Atomic Energy Commission, Washington, D. C.). Dec 1972. 70p. Dep. NTIS.

The environmental impact of constructing and operating proposed additional high-level waste management facilities at the Savannah River Plant is estimated in terms of the radioactivity release from operation of liquid waste evaporators, radioactivity release from storage of waste in liquid and salt-cake form, population dose from such releases, and damage to land from construction activities. In assessing and balancing the benefits against cost, and after considering available alternatives and their environmental impact, it was concluded that storage tanks for high activity wastes, evaporators, and auxiliaries should be designed and constructed as needed. (LCL)

17247 (WASH-1529(Dr.)) CALCINED SOLIDS STORAGE ADDITIONS, NATIONAL REACTOR TESTING STATION, IDAHO. Draft environmental statement. (Atomic Energy Commission, Washington, D. C.). Dec 1972. 63p. Dep. NTIS.

The environmental impact of constructing and using additional calcined waste storage facilities at the National Reactor Testing Station in Idaho is estimated. The storage addition will consist of stainless steel bins in a reinforced concrete vault designed to withstand credible earthquakes, floods, and storms. The environmental effects will include commitment of one-half acre of desert land, release of a trace quantity of radioactive particulates during filling, and localized warming from the decay heat. In assessing and balancing the anticipated benefits against the environmental and economic costs, and after considering alternatives, it was concluded that the proposed Calcined Solid Waste Storage Facility should be constructed and used. (LCL)

17248 IMPACT OF COMPUTER TECHNIQUES ON THE METHODS AND ORGANISATION OF RADIATION PROTECTION. Clarke, R. H.; Macdonald, H. F. (Central Electricity Generating Board, Berkeley, Eng.). pp 559-75 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Some of the computer techniques, already accepted by the GEGB, for use during accidental and operational monitoring of nuclear facilities are outlined, together with the implications on experimental procedures and methods of determining doses. Examples are given for environmental monitoring, contamination problems, and analysis of measured data. It is concluded that fast computer techniques have enabled revision of procedures in radiation protection and have shown those areas where further research is necessary. It is further concluded that some of the current concepts in radiation protection may need revision in the light of these newer calculational techniques, both for existing and future nuclear reactor types. (France)

17249 HIGH RELIABILITY ENVIRONMENTAL RADIATION MONITORING AND EVALUATING SYSTEM. Stephens, L. D. (Univ. of California, Berkeley); Dakin, H. S. pp 753-75 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Centralized monitoring and recording of accelerator-produced radiation fields at points within the Lawrence Berkeley Laboratory site is done by a telemetry system which began operation in 1964. Using standard telephone lines, the system collects data simultaneously from all points, giving both the rate and the time-integrated intensity of radiation at each point. At the collection stations conventional counting equipment is used in conjunction with a simple device which converts scaler decade output signals into a form which is transmitted over telephone lines. This directly activates electromechanical event-recorder movements and impulse counters. Transmission of signals from two consecutive decades of a single scaler at a remote station over a single telephone line makes it possible to record a wide range of radiation intensities, extending over several orders of magnitude. For special applications apart from the regular operation of the system, telephone lines transmit 5-μsec pulse signals and small count rate metering currents with noise interference practically eliminated by means of ground isolation and common-mode rejection techniques. A computer program (PLOTDOG) is then used as a means of evaluating the environmental radiation. It provides a printout and bar graph plot of the daily or hourly radiation dose for each monitoring station. The data from each of these stations can be intercompared to provide information as to causes of significant increases of the machine produced radiation or the effect of new shielding situations on the overall stray radiation patterns. (France)

17250 DATA. Section IV. Other Data. Radiat. Data Rep.; 13: No. 12, 709-719(Dec 1972).

Radiological surveillance data from the environs of the Florida Power Corporation's Crystal River Power Reactor Site are reported for 1971. Environmental levels of radioactivity in the environs of the Brookhaven National Laboratory are reported for January to June 1970. The status of all present and proposed nuclear power reactors in the United States as of September 30, 1972 is presented. Seismic signals, presumably from a Soviet underground nuclear explosion, were recorded by the United States on November 1 and November 24, 1972. (ERB)

17251 ENVIRONMENTAL RADIOACTIVITY IN ILLINOIS, 1970. Shmuklarsky, M. J. (Environmental Protection Agency, Washington, DC). Radiat. Data Rep.; 13: No. 11, 589-618(Nov 1972).

The contribution of radioactivity to the Illinois environment during 1970 resulting from the operation of nuclear power plants and from other major natural and manmade sources is presented. The environmental surveillance programs of the Dresden, Quad-Cities, and Zion nuclear power stations are described. Dresden Unit 1 radioactive gaseous and liquid releases for the past 11 yrs, and Dresden Unit 2 discharges for 1970 are summarized. On the basis of data gathered during 1970, it was concluded that the effect of nuclear power plant operations on the radioactivity level of most environmental media was hardly distinguishable from natural and fallout radioactivity. The only measured environmental radiation effect of nuclear power generation within the State was an apparent increase of a few millirem per year in the external background exposure in the vicinity of Dresden-1. (auth)

17252 DATA. Section IV. Other Data. Radiat. Data Rep.; 13: No. 10, 577-588(Oct 1972).

Data on off-site surveillance around the Nevada Test Site during July through December 1969 are presented. Environmental levels of radioactivity in the vicinity of the Knolls Atomic Power Laboratory and the Rocky Flats Plant during 1969 are also presented. The USAEC conducted two underground nuclear tests at the Nevada Test Site during September 1972. Seismic signals, presumably from a Soviet nuclear test were recorded by the USAEC on September 21, 1972. (ERB)

17253 DATA. Section IV. Other Data. Radiat. Data Rep.; 13: No. 11, 646-651(Nov 1972).

Environmental levels of radioactivity at the SIC Prototype Reactor Facility and the Shippingport Atomic Power Station during 1970 are reported. Seismic signals, presumably from a Soviet underground nuclear explosion, were detected by the USAEC on October 3, 1972. (ERB)

Atmosphere

Refer also to abstracts 17157 and 17687.

17254 (AEC-tr-7410) STUDIES OF AIRBORNE RADIOACTIVE MATERIAL DERIVING FROM AN UNDERGROUND NUCLEAR BURST IN THE USSR ON 23 MARCH 1971. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Translation of Report FOA-4-4502-A-1. 20p. Dep. NTIS.

Short lived radioactive materials, primarily ^{140}Ba (half life 12.8 days) were collected in ground-level air samples taken in various parts of Sweden at the end of March and the beginning of April 1971. Activity composition and cloud trajectory calculations, in conjunction with seismological observations, indicate that the most likely explanation for this radioactivity is a leak from an underground nuclear burst to the west of the Urals in the USSR on 23 March 1971. Results are given of gamma spectrometric measurements done on ground air samples collected during the actual period, as well as calculations of the amount and composition of the fresh radioactivity. (auth)

17255 (ARMS-69.6.7) AERIAL RADIOLOGICAL MEASURING SURVEYS OF THE OYSTER CREEK NUCLEAR POWER PLANT, AUGUST 1969. Doyle, J. F.; Burson, Z. G.; Boyns, P. K. (eds.) (Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.). Jan 1973. 22p. (EGG-1183-1546). Dep. NTIS.

The Aerial Radiological Measuring System (ARMS) was used to perform an aerial radiological survey of the Oyster Creek Nuclear Power Plant and surrounding area during August 1969. A high-sensitivity detection system collected gamma spectral and gross-count data. The data were then computer processed into an iso-exposure contour map, 3 feet above the ground, of a 240 square mile area. Results indicated the presence of isotopes normally found in the background radiation throughout the United States. No apparent anomalies were detected that could be attributed to Oyster Creek Reactor operations. (auth)

17256 (BNWL-B-234) HANFORD ENVIRONMENTAL SURVEILLANCE ROUTINE PROGRAM: MASTER SCHEDULE, CY 1973. Effective January 1, 1973. Bramson, P. E.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash.). Dec 1972. Contract AT(45-1)-1830. 210p. Dep. NTIS.

Tabulated data are presented on the monitoring of radioactivity in various environmental samples collected in the environs of BNWL, Richland, Washington. The current schedule is shown. (CH)

17257 (KFK-1667) GRAPHICAL EVALUATION OF EXPERIMENTS TO DETERMINE ATMOSPHERIC DISPERSION WITH TRITIATED WATER VAPOR AS THE TRACER. Koenig, L. A.; Winter, M. (Kernforschungszentrum, Karlsruhe (West Germany)). Nov 1972. 38p. (In German). Dep. NTIS (U. S. Sales Only).

Atmospheric dispersion experiments with tritiated water vapor as the tracer were conducted. The height of the source was 100 m. Air humidity samples were frozen on cold surfaces at up to 25 points in the field of dispersion. In nine successful experiments a total of 39 concentration distributions were determined. The tritium concentration was measured with a liquid-scintillation spectrometer. For a constant rate of emission and a known absolute air humidity the dispersion factor averaged over one sampling period can be indicated. For better comparison with the theoretical values of the dispersion factor, the values derived from the measurements were normalized to the wind velocity of 1 m/sec through multiplication by the wind velocity averaged over the sampling period and the height of emission. Only graphical evaluation was made in order to represent the dependence on the distance of the azimuthal maximum of the dispersion factor for the diffusion category prevailing during the entire period of each experiment. The results show considerable deviations from theoretical values both with respect to the amounts and the source

distances of the absolute maxima of concentration. A remarkable feature was the distribution over time of values for the dispersion factor found within one to two hours. The results do not permit any final interpretation, but they enable an estimate to be made of the dispersion factor based on the measurements. (auth)

17258 (SCPRI(RM)-9-1972 and Suppl.) REPORT OF ACTIVITY, SEPTEMBER 1972. (Service Central De Protection Contre Les Rayonnements Ionisants, Le Vesinet (France)). Sep 1972. 34p. (In French). Dep. NTIS (U.S. Sales Only).

The responsibilities of the Central Service for Protection against Ionizing Radiations (SCRPI) of France are summarized. Results of radiation monitoring of personnel and of the environment at various locations during September 1972 are reported. (CH)

17259 (SCPRI(RM)-10-1972 and Suppl.) REPORT OF ACTIVITIES, OCTOBER 1972. (Service Central de Protection Contre les Rayonnements Ionisants, Le Vesinet (France)). 1972. 44p. (In French). Dep. NTIS (U.S. Sales Only).

The responsibilities of the Central Service for Protection against Ionizing Radiations (SCRPI) of France are summarized. Results of radiation monitoring of personnel and of the environment at various locations during October 1972 are reported. (CH)

17260 (UCRL-51328) INVESTIGATION OF SCAVENGING OF RADIOACTIVITY FROM NUCLEAR DEBRIS CLOUDS: RESEARCH IN PROGRESS. Crandall, W. K.; Molenkamp, C. R.; Williams, A. L.; Fulk, M. M.; Lange, R.; Knox, J. B. (California Univ., Livermore. Lawrence Livermore Lab). 17 Jan 1973. Contract W-7405-eng-48. 40p. Dep. NTIS.

Research projects currently under way at LLL on radioactivity scavenging are reported. Specifically, these projects are: a study of the dynamics of cumulus cloud interaction with a nuclear debris cloud to determine possible enhancement or reduction in peak surface concentrations; a study of the microphysical interactions of debris particles with cloud droplets and raindrops to determine rainout and washout efficiencies; a study to determine the feasibility of rendering the debris particles non-wettable, thereby effectively making the rainout coefficient negligibly small; a study of the potential effects of dry deposition due to the detonation of larger numbers of low yield devices within a confined area; and the development of a three-dimensional atmospheric diffusive particle-in-cell code capable of calculating the time-dependent distribution of air pollutants under conditions of turbulent diffusion and wind shear. (auth)

17261 EVOLUTION OF AIR CONTAMINATED BY A NUCLEAR EXPLOSION ENCOUNTERED BY A BALLOON OVER THE SOUTH PACIFIC. Doury, A. (CEA, Paris). Meteorologie; No. 12, 9-26(Oct 1969). (In French).

On the 3rd and 4th of September 1968, a constant level balloon intended for solar x-ray detection at the 100mb level encountered air masses radioactively contaminated by recent nuclear experiments. The trajectories of several elements in these air masses were studied during a period of several days; an attempt was made to estimate the level of radioactivity, and to interpret the circumstances associated with the encounter. The shape and magnitude of the signals are discussed. The three-dimensional aspect of the motion of the clouds and the balloon are considered, uncertainties in determining position and altitude being taken into account. (France)

17262 ^{222}Rn, CO, CH_4, AND CONTINENTAL DUST OVER THE GREENLAND AND NORWEGIAN SEAS. Larson, R. E.; Lamontagne, R. A.; Wilkniss, P. E.; Wittmann, W. I. (Naval Research Lab., Washington, DC). Nature (London); 240: No. 5380, 345-347(8 Dec 1972).

The measurements were made in connection with a study of air mass trajectories. Radon-222 emanates essentially from continental land areas and a continental ^{222}Rn component can be detected in a marine air mass. Radon measurements indicate that monsoon air masses contain continental air. Data on radon, dust, CO, and CH_4 obtained during an Arctic cruise of the USNS Mizar in August 1971 are reported, and air mass trajectories were established. Dust concentrations were determined by neutron activation analysis. Agreement between continental dust and radon data indicates that in remote ocean areas radon is a good tracer for continental air masses. (UK)

17263 TREATMENT OF RESULTS FROM ATMOSPHERIC SAMPLING BEFORE COMPUTER PROCESSING. Cohen, P. (CEN, Fontenay-aux-Roses, France). pp 589-98 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The operators prepare the punched tapes by typing sample data manually. The results of the counts are then automatically transcribed as the samples pass through the sample changers. The punch tapes are then fed into a Gamma 10 computer, which prints out a list of results, the contamination deposited on each sample being expressed in MPC. In addition the computer uses the results to edit individual reports on internal contamination arising from contaminated atmospheres and atmospheric contamination from laboratories. Serializer-digitizers present a saving in time and enhance the reliability of the computer calculated results. (France)

17264 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 13: No. 12, 697-707(Dec 1972).

Data are presented on the radioactivity in airborne particulates and precipitation during August 1972 as reported by the Radiation Alert Network, Canadian Air and Precipitation Monitoring Program, Pan American Air Sampling Program, California Air Sampling Program, and the Air Surveillance Network of the National Environmental Research Center at Las Vegas. Data are also presented on the plutonium content of airborne particulates at selected stations of the Radiation Alert Network during March 1972. (ERB)

17265 MEASUREMENT OF THE NATURAL RADIOACTIVITY OF THE ATMOSPHERIC DUST IN BUCHAREST. Zoran, Maria (Astronomical Observatory, Bucharest); Zoran, Valeriu. Rev. Roum. Phys.; 17, No. 8, 901-919(1972).

Measurements of the daily variation of the short lived α- and β radioactivity of the atmospheric dust were made in Bucharest during the spring of 1971. The air filter method was used. Atmospheric pollution was estimated from the degree of blackness of the filter. The dependence of the measured radioactivity on the meteorological variables such as the air temperature, pressure, and humidity, the amount of precipitation, and wind velocity and direction was considered qualitatively, as well as by computing the correlation coefficients. An attempt to measure the radioactive balance between ^{218}Po and ^{214}Pb was performed. A linear time dependence of the radon daughters concentrations in the air was introduced in the equations describing the accumulation of the decay products in the filter. The equilibrium was most closely approached early in the morning. Based on the equilibrium measurements, the radon concentration at 17 m above the ground was found to vary on the average from 50 to 190 pCi m^{-3}. (auth)

17266 STUDIES ON THE RADIOACTIVITY IN RAIN AND AIRBORNE DUST FROM 1965 TO 1969 IN AICHI PREFECTURE. Toyoshima, K. (Aichi Inst. of Public Health, Nagoya, Japan); Kozima, I.; Kagami, T.; Hayashi, J.; Koike, K. Aichi-Ken Eisei Kenkyusho-Ho; No. 21, 157-162(Mar 1971). (In Japanese).

At present, measurements of total β radioactivity in rainwater, dust, service water, river water and sewage, seawater, agricultural and live stock products, soil, and fish, shellfish and seaweeds, and measurements of spatial radiation dose with scintillation survey meters are carried out in Aichi prefecture. The measurement of total β radioactivity for the rainwater showed a maximum value of 600 pCi/l in January 1965, and it was always below 1000 pCi/l and within the range of normal values. Measured values of the total β radioactivity for the suspended dust were 0.49 pCi/m3 on the average, and within range of normal value below 1.0 pCi/m^3. Investigating a peak shown in a 3 months average of the β radioactivity for the suspended dust, a nuclear explosion carried out by Communist China seemed to affect the area after 9 months ±2 months. (Japan)

17267 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 13: No. 11, 636-645(Nov 1972).

Data are presented on the radioactivity in airborne particulates and precipitation during July 1972 as reported by the Radiation Alert Network, Canadian Air and Precipitation Monitoring Program, Pan American Air Sampling Program, California Air Sampling Program, and the Air Surveillance Network of the National Environmental Research Center at Las Vegas. (ERB)

17268 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 13: No. 10, 565-575(Oct 1972).

Data on the gross beta radioactivity in surface air and precipitation samples collected by the Radiation Alert Network and the Canadian Air and Precipitation Monitoring Program during June 1972 are presented. Data on the gross beta radioactivity in surface air samples collected by the Pan American Air Sampling Program, the California Air Sampling Program, and the Air Surveillance Network of the National Environmental Research Center, Las Vegas during June 1972 are also presented. All data are presented in tabular form. (ERB)

Soil

17269 RADIOACTIVE CONTAMINATION OF THE SOIL AND THE RELATED RADIOLOGICAL RISKS. Kirchmann, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Ann. Gembloux; 77: 207-223(1971). (In French).

Natural sources of radioactive contamination, as well as contamination by fallout as a result of nuclear weapon tests, and contamination resulting from the peaceful uses of nuclear energy are surveyed. The radiological risks of external radiation and the contamination of the food chain and ground water are discussed. (INIS)

Water

Refer also to abstract 17022.

17270 RADIOACTIVE CONTAMINATION IN THE TEJO ESTUARY. Marques, B. E.; Sales Grade, M. R. pp 887-920 of New Trends in Radiation Protection. Montrouge, France: Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The distribution of ^{137}Cs and ^{90}Sr in the Tejo estuary was studied in view of developing a mathematical model to predict the movements and future behavior of these isotopes. (France)

17271 RADIOACTIVE CONTAMINATION OF THE NORTH ATLANTIC OCEAN. Marques, B. E.; Sales Grade, M. R.; Ribeiro, F. M. R. pp 921-42 of New Trends in Radiation Protection. Montrouge, France: Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The methods used to isolate ^{137}Cs and ^{90}Sr from large volumes of sea water are described. The results indicate the level of contamination of the Atlantic Ocean between the latitudes 41 deg 31'N and 36 deg 19'N and the longitudes 10 deg 30'W and 7 deg 22'W. (France)

17272 DATA. Section II. Water. Radiat. Data Rep.; 13: No. 12, 685-695(Dec 1972).

Data are presented on the gross radioactivity in surface waters of the United States during April 1972, and on the gross radioactivity and tritium content of surface waters in Alaska, California, Nevada, and Utah during January through March 1972. (ERB)

17273 DATA. Section II. Water. Radiat. Data Rep.; 13: No. 11, 629-635(Nov 1972).

Data are presented on the gross radioactivity in surface waters of the United States during March 1972, radioactivity in Minnesota municipal water supplies during July 1970 through June 1971, and the ^{90}Sr content of New York City tap water during July through December 1971. (ERB)

17274 DATA. Section II. Water. Radiat. Data Rep.; 13: No. 10, 557-564(Oct 1972).

Data are presented on the gross radioactivity in surface waters of the United States during February 1972 and on the gross radioactivity in Lake Michigan and ^{90}Sr, ^{137}Cs, uranium, thorium, tritium, and ^{226}Ra contents of water from Lake Michigan during August and September 1970. All data are presented in tabular form. (ERB)

Ecosystems and Food Cycles

Refer also to abstracts 17580, 17685, 17694, 17705, 17713, and 17715.

17275 (WASH-1504) ENVIRONMENTAL STATEMENT, UNDERGROUND NUCLEAR TEST PROGRAMS. Nevada Test Site (Tests of One Megaton or Less). (Atomic Energy Commission, Washington, D. C.). Sep 1971. 89p. Dep. NTIS.

The probable added impact on the environment due to continued underground nuclear tests of one megaton or less at the Nevada Test Site (NTS) will be small. This statement is based, in part, upon the experience gained from the execution of all underground nuclear tests since the signing of the limited test ban treaty in 1963, 222 of which had been announced through July 31, 1971. Testing during FY 1972 will be at a level comparable to recent years. Radioactivity will be created in an intense form in the underground cavities formed by the nuclear detonations. In spite of carefully planned and executed preventive measures, inadvertent release of radioactivity which may be detectable offsite is a possibility. Based upon past experience, the magnitude of such release could range up to 10^6 curies (at H + 12 hours) at the point of release; however, only minimal environmental effects would be anticipated because of dilution before such releases get offsite. Even so, precautions are taken on each test to protect the public in case any release does occur. In addition, some noble gases such as ^{85}Kr may slowly seep to the surface from sites of underground explosions. No observable or significant environmental effects are expected from such release. Normally such seepage release is detectable only locally and in trace amounts requiring sensitive laboratory equipment for detection. The terrestrial ecosystem will be affected by the creation of several new subsidence craters (surface sinks above the point of nuclear detonations) in addition to those already in existence. Larger yield tests may be expected to create minor rockfalls along cliff faces on the NTS. In the unlikely event of a significant release of radioactivity, there is a slight chance of localized onsite effects to plant life and consequent alterations to small animal habitats. Some disturbances to the natural environment will result from normal construction and test support activities. Offsite terrestrial ecosystem effects are not expected. The environmental costs, which are discussed in detail, have been balanced against the benefits to be derived from underground nuclear testing. These benefits are summarized. (CH)

17276 ^{90}Sr CONTAMINATION OF POWDERED MILK. Weissbauch, H.; Botezatu, E.; Pincu, A. (Institutal de Sanatate Publica si Cercetari Medicale, Iasi). Igiena (Bucharest); 20: No. 2, 95-99 (1971). (In Rumanian).

Twenty-seven samples of powdered milk collected from four regions of Romania during 1971 had ^{90}Sr contents ranging from 4.08 to 8.30 pCi/100g. It was determined that more than 90% of the total β-emission of the samples was due to the content of natural ^{40}K. (ERB)

17277 TRITIUM IN THE BIOSPHERE AND ITS TRANSFER TO THE FOOD CHAIN. Kirchmann, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium); Van den Hoek, J. J. Belge Radiol.; 55: No. 2, 233-242(1972). (In French).

Tritium in the environment originates from natural and artificial sources: the natural production ratio (interaction, cosmic rays on nitrogen and oxygen in the air) and the artificial production ratio (nuclear bomb explosions, power reactors) are indicated. Data on the movement of tritium in the environment and estimates of tritium production and release by nuclear installations are given and briefly commented on. The ways in which plant-life is contaminated are numerous (absorption by root or leaf, vapour exchange) and the mechanism responsible for tritium incorporation in plant organic matter is that of photosynthesis. (auth)

17278 SURVEY OF STUDIES ON THE CONTAMINATION OF FOOD. Cantillon, C. E. (Institut d'Hygiene et d'Epidemiologie, Brussels). J. Belge Radiol.; 54: No. 3, 433-439(1971). (In French).

The Institut d'Hygiene et d'Epidemiologie and the Centre d'Etude de l'Energie Nucleaire have jointly set up a program of analyses for measuring the level of contamination in the principal kinds of foods and estimating the daily ingestion of radioactivity due to food. The sampling program and the trend in the radiocontamination from 1964 to 1969 are described. There is a close relation between variations in milk contamination and those of the total diet, and there is a decrease in daily ingestion, rather slow for ^{90}Sr, much faster for ^{137}Cs. For ^{90}Sr, the curve has leveled out, and the inaccuracy of sampling therefore takes on a great importance. The radioactivity ingested has remained below the level generally accepted for the population. (auth)

17279 DATA. Section I. Milk and Food. Radiat. Data Rep.; 13: No. 12, 659-683(Dec 1972).

The following data on radionuclide concentrations in milk and food are reported: concentrations of ^{90}Sr and ^{137}Cs in milk in United States, Canada, and Central and South America during September 1971 through August 1972; ^{137}Cs, ^{89}Sr, ^{90}Sr, and tritium content of milk in California, Nevada, and Utah during January through March 1972; estimated daily intake of radionuclides in California diets during January to June 1971; estimated daily intake of radionuclides in Connecticut diet during 1971; and ^{90}Sr content of diets in New York City and San Francisco during 1971. (ERB)

17280 DATA. Section I. Milk and Food. Radiat. Data Rep.; 13: No. 11, 619-628(Nov 1972).

The concentrations of ^{137}Cs and ^{90}Sr in milk in Canada, the United States, Central and South America are reported on the basis of samples obtained during August 1971 through July 1972. The ^{90}Sr content of milk in New York City during 1971 is also reported. (ERB)

17281 DATA. Section I. Milk and Food. Radiat. Data Rep.; 13: No. 10, 547-556(Oct 1972).

The ^{137}Cs and ^{90}Sr concentrations in milk samples collected during June 1972 in Canada, the United States, Central America,

and South America are reported. The average concentrations for the preceding 12 months are also reported. All data are presented in tabular form. (ERB)

Radiometric Techniques

Refer also to abstracts 17200, 17236, and 17437.

17282 (BARC-624) THEORY FOR THE QUANTITATIVE ESTIMATION OF BED LOAD TRANSPORT USING RADIOISOTOPES. Krishnamurthy, K.; Rao, S. M. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 10p. Dep. NTIS (U. S. Sales Only).

An attempt was made to develop a simple theory for the application of radiotracer techniques to estimate the quantum of bed material transported in rivers, estuaries etc. The emphasis is mainly on the physical concepts involved. Certain assumptions made in the theory are later verified experimentally. (auth)

17283 (RISO-249(Pt.3), pp 880-894) NEW TECHNIQUES OF THERMOLUMINESCENT DATING OF ANCIENT POTTERY. I. THE SUBTRACTION METHOD. Fleming, S. J.; Stoneham, D. (Research Lab. for Archaeology and History of Art, Oxford). Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Accurate thermoluminescent dating by the fine-grain and the inclusion methods is possible, provided a reasonable knowledge of the burial circumstances (i.e., soil radioactivity and water uptake) is established from "on site" measurements. However, the two routine methods differ in one essential feature. The source of fine-grains (around 1 micron in diameter) in pottery are all three forms of natural radiation, α, β, and γ (and a small cosmic-ray component). Quartz grains (around 100 microns in diameter) embedded in the clay matrix only experience β and γ radiation as the α radiation that originates in the matrix only partially penetrates such large crystals. Use of the two methods "in tandem" allows the environmental component to be eliminated. The difference of the archaeological doses that each method yields leaves a dose dependent only on the single component of α radiation, a parameter that is internal to the pottery. The importance of factors such as sherd water uptake, radon emanation, and pottery pore size is discussed with respect to the subtraction technique and exampled by material from the Roman Fort at Baginton, England. Applications of the new method are given for (i) pottery from Yotoco Ferry, Columbia, (ii) pottery from the Neolithic site of Hacilar in Turkey, and (iii) an Etruscan bust in terracotta. Age determination here is estimated to have an accuracy of around ±12%, but close note must be made of various pottery parameters that control that accuracy, before the lengthy process of the subtraction technique is embarked upon. (auth)

17284 (RISO-249(Pt.3), pp 895-929) NEW TECHNIQUES OF THERMOLUMINESCENT DATING OF ANCIENT POTTERY. II. THE PREDOSE METHOD. Fleming, S. J. (Research Lab. for Archaeology and the History of Art, Oxford). Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The magnitude of a radiation dose may be measured utilizing the increase it produces in the thermoluminescent sensitivity of quartz in a glow curve peak at 110°C. The sensitivity enhancement is activated by heating the quartz to 500°C after application of the pre-irradiation dose (briefly termed the predose). Little growth of sensitivity is observed for an activation temperature of only 150°C. An enhancement rate of 5% per rad is typical for quartz freshly annealed from its geological condition at temperatures of between 700 and 1000°C. Such heating conditions would match that experienced by quartz in pottery during the kiln-firing in ancient times. A test program of 21 shreds from 10 British sites spanning Mediaeval and Roman times illustrates application of this predose dating method. Criteria are developed for the suitability, or otherwise, of material to be dated in this way. An accuracy of dating per sherd for 14 sherds within 5% of the known archaeological age was obtained. Practical applications of the predose dating method include study of (i) a recently-manufactured Etruscan wall-painting on terracotta, (ii) a quartz core from a Degas bronze dating from around 1920, and (iii) authenticity analysis of a Hacilar figurine where discussion is extended into investigation of whether that piece may have been re-heated in modern times. (auth)

17285 (RISO-249(Pt.3), pp 930-947) PROGRESS IN TL DATING AT RISOE. Mejdahl, V. (Danish Atomic Energy Commission, Risoe). Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

An outline is given of a dating technique based on the thermoluminescence emitted by quartz and feldspar inclusions of size 0.3 to 0.5 mm. Beta and gamma intensities were measured with $CaSO_4$: Mn and $CaSO_4$: Dy, respectively. Results are presented from a dating program comprising sherds, bricks, burned stones, and burned clay (from kilns) from seventeen excavation sites ranging in age from A.D. 1600 to 4000 B.C. (auth)

17286 (RISO-249(Pt.3), pp 948-959) SOME UNCERTAINTIES IN THERMOLUMINESCENCE DATING. Han, M. C.; Ralph, E. K. (Univ. of Pennsylvania, Philadelphia). Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

In recent experiments with ^{210}Po sources, an attempt was made to determine the precise range of alphas in clays so that an absolute comparison between the effects could be made. A study of the decay series of ^{238}U and ^{232}Th also indicated the necessity of knowing the proportions of these two elements in each sample before any estimation of the total dose from inherent radioactivity can be made. Until more measurements and studies are made and the magnitude of these uncertainties is reduced, greater reliability may be achieved by the so-called "relative" method, that is, by calculating TL dates from a calibration curve based on samples of known age. This procedure circumvents the problem of estimating the total inherent natural radioactivity. (auth)

17287 (SLA-73-85) USE OF DELAYED NEUTRONS TO DETERMINE URANIUM CONTENT IN BORE HOLES WITHOUT CORING. Igumnov, S. A. Translated by Patricia Newman (Sandia Labs., Albuquerque, N. Mex.) from Izv. Vyssh. Ucheb. Zaved., Gorn. Zh.; 9: No. 2, 3-6(1966). 7p. Dep. NTIS.

The physical principles and advantages of delayed neutron activation as a method for determining the U content in a borehole are discussed. It was concluded that: a statistical accuracy of 15% can be achieved on an ore with 0.5% U content using a source of $2 \cdot 10^7$ neutrons/sec and a thermal neutron counter, the factors which distort gamma logging data do not affect data obtained by delayed neutron logging; and more experimental work is needed to precisely evaluate the performance of neutron logging. (LCL)

17288 ^{137}Cs GAMMA-RAY ABSORPTION IN ECLOGITES. Vankova, Vera; Babuska, Vladislav (Geophysical Inst;, Prague). Stud. Geophys. Geod.; 16: No. 4, 383-392(1972).

The coefficient of gamma absorption $\mu_{^{137}Cs}$ investigated in eclogites of the Bohemian Massif varies with fresh samples from 0.2477 cm^{-1} to 0.2804 cm^{-1}. Symplectite is the main factor decreasing the value of μ down to 0.242 cm^{-1}. On the contrary, the coefficient μ increases with the increasing content of clinopyroxene and especially of garnet. The linear dependence of the coefficient μ on the density ρ may be expressed by the equation $\mu = 0.0682\rho + 0.028$. (auth)

17289 DEVICE FOR INSERTING TAGGED SAND INTO OCEAN FLOOR. Acree, E. H.: Brashear, H. R. Jr.: Case, F. N. (to United States Atomic Energy Commission). U. S. Patent 3,697,756. 10 Oct 1972. Filed 7 Jul 1971.

A device is provided for introducing an identifiable radioisotope tag into the ocean bottom in such a manner that a radiation material balance can be observed as the sand transport process occurs. The device comprises a cylinder having a motor-operated stirrer for admixing sand and a quantity of isotope tagged sand, the cylinder being mounted on a sled in such a manner that it can be depressed vertically by means of a hydraulic ram into the ocean bottom. (Official Gazette)

17290 DETERMINATION OF STRUCTURAL COEFFICIENTS FOR CHARACTERISTIC SINGLY SCATTERED RADIATION. Kudryavtsev, Yu. I. Uch. Zap. Leningrad. Gos. Univ., No. 366, Ser. Fiz. Geol. Nauk; No. 22, 93-106(1972). (In Russian).

Regulated or near-regulated models having an accurate analytical expression for the intensity were required for investigating nonhomogeneous geological media. A laminated model and a model with discrete, cylindrical occlusions were considered, and formulas were developed for calculating structural coefficient curves for characteristic radiation, having given the energies of various sources of gamma radiation. (KSW)

17291 SOIL THERMOLUMINESCENCE IN RELATION TO RADIATION EXPOSURE UNDER FIELD CONDITIONS. Nishita, H.; Hamilton, M. (Univ. of California, Los Angeles). Soil Sci.; 114: No. 6, 430-439(Dec 1972).

Experiments were conducted to determine the relationship of soil thermoluminescence to ionizing radiation exposure under the conditions of natural environment using the ^{137}Cs radiation field at the Nevada Test Site. In experiment I soil columns were buried in the ground and irradiated at a fixed distance from the ^{137}Cs

source. In experiment II, they were exposed on to ground surface at 12 different distances from the source. Soil thermoluminescence was determined in three ways, i.e., glow curve area below 200°C, glow curve height at 200°C, and total area. Both experiments showed that soil thermoluminescence is highly correlated with radiation exposure level. The first two methods of measuring thermoluminescence indicated above gave correlation coefficients $r > 0.915$. The total area method gave high correlation coefficient $r > 0.951$ for the noncalcareous soil, but low coefficient $r < 0.769$ with the highly calcareous soil studied, indicating that this method cannot be applied to the latter soil type. Under the experimental conditions that prevailed, the minimum radiation exposure level required to produce measurable soil thermoluminescence appeared to be in the 20 to 85 R range. (auth)

17292 COSMIC RAY PRODUCED SPALLATION PRODUCTS IN ATMOSPHERIC RESEARCH. Roedel, W. (Univ., Heidelberg). Naturwissenschaften; 59: No. 10, 456-63(Oct 1972). (In German).

Cosmic radiation induces spallations in the constituents of the air. By this mechanism several radioactive isotopes are produced in the atmosphere. These nuclides are a useful tool for tracer experiments in environmental sciences. The isotopes attached to atmospheric aerosols are considered; applications of these radioactive species for studying the behavior of trace substances and pollutants in the atmosphere are reviewed. (auth)

17293 GENERATING, CONTROL, AND ADMINISTERING OF A RADIOACTIVE AEROSOL. Kientzel, J. M. (Laboratoire Central de l'Armement, Arcueil, France). pp 99-126 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

A general method of radioactively contaminating the respiratory tract, which enables the physical parameters of the aerosol and the respiratory parameters to be kept under control, is described. The aerosol used was obtained from ferric oxide powder labeled with ^{140}La and ^{59}Fe. An aerosol of practically uniform sized particles (1 μm to 1.6 μm) was formed by elutriating the smallest particles on a two-component fluidized bed. The control of the concentration and granulometry of the aerosol was effected by associating a photometric particle detector, ROYCO 225, with a 64 channel analyzer. The aerosol can be administered to animals using the BIRD respiratory apparatus. The aerosol production rate is controlled by pulsed fluidization, in accordance with the required flow and breathing rate. Although this method is limited to labeling with La and Y, labeling with other fission products is envisaged. (France)

17294 USE OF FALLOUT ^{137}Cs AS A TRACER TO DEFINE THE RECENT DELTAIC FACIES OF A RIVER. Plato, Phillip; Goldman, G. C. (Univ. of Michigan, Ann Arbor). Radiat. Data Rep.; 13: No. 12, 653-657(Dec 1972).

Using fallout cesium-137 as a tracer, the size and location of the deltaic facies in Lake Michigan of the St. Joseph River are described. Approximately 185 sediment samples were collected and analyzed for cesium-137 aboard ship during five working days. Contour lines are shown that represent the measured concentrations of cesium-137 in the deltaic facies produced by the St. Joseph River. (auth)

17295 MEASUREMENT OF GAMMA ENERGY DISTRIBUTION FROM ^{137}Cs IN THE BOREHOLE. Nakai, J. (Geological Survey of Japan, Kawasaki). Chishitsu Chosasho Geppo; 22: No. 10, 547-558(Oct 1971). (In Japanese).

The response of a $1\frac{3}{4}$ in. dia. by 2 in. long sodium-iodide scintillator to isotropic incident gamma rays was studied and presented as a 14 by 14 matrix for the energy range from 0 to 0.7 MeV. Energy flux spectra of gamma rays from a ^{137}Cs point source in the artificial well were measured with a scintillation spectrometer. Comparison of these spectra may be useful for the research of gamma–gamma density logging. (auth)

Site Surveys

Refer also to abstracts 17213, and 17245–17247.

Thermal Effluents

Refer also to abstracts 17238, 19195, 19217, 19224, and 19230.

17296 (EEI-65-901) WATER TEMPERATURES AND AQUATIC LIFE. Wurtz, C. B.; Renn, C. E. (Johns Hopkins Univ., Baltimore, Md.). 1 Jun 1965. 105p. Edison Electric Inst., New York, NY $2.00.

For Edison Electric Inst., New York, NY.

A literature review of the effects of temperature variations on fishes and invertebrates is presented. Effects of thermal discharges from power reactors are included. (262 references) (HLW)

17297 (HEDL-TME-72-131) THERMAL EFFECTS OF PROJECTED POWER GROWTH: SOUTH ATLANTIC AND EAST GULF COAST RIVER BASINS. Engstrom, S. L.; Bailey, G. F.; Schrotke, P. M.; Peterson, D. E. (Hanford Engineering Development Lab., Richland, Wash.). Nov 1972. Contract AT(45-1)-2170. 168p. Dep. NTIS.

Direct cooling capacities of twelve major southeastern river systems were calculated for average and low flow conditions. Total regional cooling capacities considering not only the direct heating of the rivers, but also their ability to dissipate heat to the atmosphere, ranged from a high of 328 GW_T to a low of 65 GW_T. The Alabama, Apalochicola, Altamaha, and Savannah rivers contribute essentially all of the capacity based on low flow conditions. The remaining rivers (Roanoke, Pee Dee, Wateree, Congaree, Choctawhatchee, Tombigbee, and Pearl) have insufficient flow to assimilate 800 MW_T over major portions of their length under such conditions. Inclusion of the Suwannee in the Wild and Scenic Rivers Act removed from consideration only about 2 GW_T (under low flow conditions) of cooling capacity. Considering that roughly 1.7 MW_T are rejected regionally for each MWe generated (corresponding roughly to 33% efficiency in a fossil fuel plant), the available cooling capacity will support ~38 GWe at one time. Projecting the present regional practice of siting ~40% of the thermal generating capacity to utilize ocean or estuarine cooling, a total of ~65 GWe could be accommodated in the area. Although improvements in plant efficiency could increase this to 70 to 80 GWe, analysis of projected power generation patterns indicates that this is insufficient to cool, on a once-through basis, the anticipated growth in the electrical generation industry, and that recourse to supplemental cooling techniques will be required throughout much of the Southeastern United States. (auth)

17298 (HEDL-TME-72-141) THERMAL EFFECTS OF PROJECTED POWER GROWTH: NORTH ATLANTIC RIVER BASINS. Engstrom, S. L.; Bailey, G. F.; Schrotke, P. M.; Peterson, D. E. (Hanford Engineering Development Lab., Richland, Wash.). Nov 1972. Contract AT(45-1)-2170. 176p. Dep. NTIS.

Direct cooling capacities of eight major northeastern river systems were calculated for average and low flow conditions. Total regional capacity, considering not only direct heating of the rivers, but also their ability to dissipate heat to the atmosphere, ranged from a high of 214 GW_T to a low of 34 GW_T. The Hudson, Penobscot, and Susquehanna rivers contribute essentially all of the capacity based on low flow conditions. Of the remaining rivers (Kennebec, Androscoggin, Connecticut, Delaware, and Potomac), the Delaware and Potomac have insufficient flow to assimilate 800 MW_T over major portions of their length under such conditions. Considering that, on the average, in the region, 1.7 MW_T are rejected for each MWe generated (corresponding to a fossil fuel plant efficiency of roughly 33%), the available cooling capacity will support ~20 GWe at one time. Projecting the present regional practice of siting ~50% of the thermal generating capacity to utilize ocean or estuarine cooling, a total of ~40 GWe could be accommodated in the area. Although improvements in plant efficiency could increase this to some 45 GWe, analysis of projected power generation patterns indicates that this is insufficient to cool, on a once-through basis, the anticipated growth in the electrical generation industry, and that recourse to supplemental cooling techniques will be required throughout much of the North Atlantic region. This is already evident in utility planning, where presently announced plans indicate that by 1990, nearly half of the heat rejection will be through supplemental cooling devices, primarily cooling towers. (auth)

17299 INFLUENCE OF THERMAL RELEASE ON A RIVER BIOCENOSIS. Vaillancourt, G.; Couture, R.; Dube, J. pp 951-74 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

In order to study the thermal release produced in a section of Saint-Laurent River (Quebec) by the Gentilly nuclear power plant, the Thermo-pol Project was undertaken in June 1970. A series of physical, chemical, and biological measurements was made to establish the background conditions of the environment. From these data, it will be possible in the future to estimate the changes produced by the start-up of this nuclear power plant in the river biocenosis. (France)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 17926.

General Detectors and Monitors

Refer also to abstracts 17017, 17477, 17478, 17593, 17701, 18019, 18653, 18756, 18765, 18940, 18941, 19295, and 19305.

17300 (AEEW-R-803) USE OF THE ^{6}Li SEMICONDUCTOR SANDWICH SPECTROMETER FOR THE MEASUREMENT OF FAST-NEUTRON SPECTRA. Rickard, I. C. (Atomic Energy Establishment, Winfrith (England)). Jul 1972. 29p. Dep. NTIS (U. S. Sales Only).

The construction and properties of the lithium-6 semiconductor detector are discussed. The technique may be used to measure neutron spectra over the energy range 10 keV to 6 MeV. Major sources of experimental error have been isolated, enabling improvements to be incorporated into the existing electronics system. The life-span of the detectors is severely limited by fast neutron radiation damage of the silicon diodes. The lithium-6 cross-section has been remeasured to an accuracy of ±4% (one standard deviation). The method of background subtraction has been tested and found to be adequate. Fast neutron spectra have been measured in three ZEBRA assemblies in the energy range 10 keV to 6 MeV and their accuracies assessed. The experimental results are compared with results from competing experimental techniques and with the theoretical predictions made using current methods and data. It is concluded that the results provide a sufficient overlap with existing techniques to give an accurate measurement of the fast-neutron spectrum about 1 MeV. (auth)

17301 (BMBW-FBK-72-19) NEW MATERIALS FOR γ- AND X-RAY DETECTORS. Roth, S.; Willig, W. R. (Siemens A. G., Erlangen (West Germany). Forschungslaboratorien). Oct 1972. 55p. (In German). Dep. NTIS (U. S. Sales Only).

An attempt is made to replace the conventional high-resolution Ge- and Si-detectors with Pb- and Hg-compounds with better efficiency and room temperature application. Detection of α particles and γ-quanta with β-PbO and PbI_2 devices was possible up to elevated temperatures (PbI_2: 130°C). Detection of α-particles was possible with α-PbO and HgI_2 devices. Also, an account is given of research on semiconductor properties such as photoconductivity, temperature dependence of dark currents, and thermally stimulated currents. (auth)

17302 (BNL-17542) BONE DENSITY SCANNER USING γ RAY ATTENUATION WITH A Ge(HP) DETECTOR. Schmitt, J. C.; Kraner, H. W. (Brookhaven National Lab., Upton, N. Y.). Dec 1972. Contract AT(30-1)-160. 17p. Dep. NTIS.

A scanning source and detector has been developed and evaluated which measures bone density by the attenuation of ^{241}Am γ rays. It uses a high resolution Ge(HP) detector which will improve scatter rejection and is conveniently stored and operated. Standard electronic equipment is used. Density variations on the order of 3% are visible in scans at scanning rates of about 5 min per 3-inch scan. The precision or reproducibility derived from several representative scans is about 1% and should improve with use as possible systematic errors are found and eliminated. The statistical error of attenuated counts can be somewhat less than this value. (auth)

17303 (BNWL-SA-3892) BACKGROUND REDUCTION OF HIGH EFFICIENCY Ge(Li) DETECTORS. Kaye, J.H.; Brauer, F.P.; Fager, J.E.; Rieck, H.G. Jr. (Battelle Pacific Northwest Labs., Richland, Wash.). 20 May 1971. Contract AT(45-1)-1830. 7p. (CONF-711111-36). Dep. NTIS. From Nuclear Science Symposium; San Francisco, California, United States of America (USA) (3 Nov 1971).

The effect of background on the sensitivity of large Ge(Li) detector systems has been studied. Significant reductions in the number and intensity of background photopeaks and the overall background spectrum in Ge(Li) detectors have been obtained. Methods studied include material selection, cryostat design, anticoincidence shielding, massive shielding, and beta coincidence gating. (auth)

17304 (HEDL-SA-192) LONG-TERM OPERATIONAL PERFORMANCE OF FISSION COUNTERS IN HIGH GAMMA FLUX AND TEMPERATURE ENVIRONMENTS. Hoitink, N. C.; Thompson, D. C. (Hanford Engineering Development Lab., Richland, Wash). 21 Sep 1971. Contract AT(45-1)-2170. 23p. (CONF-711111-35). Dep. NTIS.

From Nuclear Science Symposium; San Francisco, California, United States of America (USA) (3 Nov 1971).

A program to select, test and evaluate commercially available neutron detectors and cables for use in the stringent gamma and temperature environments expected for the in-vessel Low Level Flux Monitor System to be used in the FFTF has been conducted. The significant details and results of this program are described. Six standard, high-sensitivity (0.7 to 1.0 counts/s/nv) fission counters from three manufacturers were included in life tests designed to evaluate performance over a 3000 to 10,000 h period at a gamma flux of 1.5×10^{6} R/h and at temperatures ranging from 300 to 350°F. Five of the six detectors were of guarded construction to take advantage of noise rejection and electrical isolation advantage. Thirty- to fifty-foot lengths of coaxial cable (mostly of the mineral insulated variety) coupled the detector signal to individual current-sensitive and charge-sensitive preamplifiers. Of the six systems tested during the investigation, three detector failures occurred. Two of the failures were the result of changes in gas composition while the third resulted from accumulation of a foreign deposit on the insulators. (auth)

17305 (IFVE-SEF-71-117) COMPENSATING COUNTING LOSSES DUE TO THE DEAD TIME IN COUNTING SYSTEMS. Rodnov, Yu. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 16p. (In Russian). INIS.

Two types of counting systems are considered, in which compensation in counting is implemented with and without an increase in the measuring time. The accuracy of measurement was determined in these systems, and it was shown that for a choice of parameters of the compensating channel, the dispersion of readout (counting) of similar systems approximated the dispersion of impulses entering the inlet. An example of a block diagram with a compensating channel for coincidence counting is presented. (tr-auth).

17306 (KFTI-70-78) MEASUREMENT OF GAMMA RADIATION LINEAR POLARIZATION WITH GeLi PLANAR DETECTOR. Gamalii, A. F.; Nesterov, B. V.; Kopanets, E. G.; L'vov, A. N.; Migalenya, V. Ya. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1971. 7p. (In Russian). INIS.

A method for measuring the linear polarization of gamma rays using a planar trapezoidal Ge(Li) detector is described. The dimensions of the detector are graphically represented, and the geometry of the polarization of the γ-rays which were generated by nuclear reactions is shown. The experimental value of linear polarization was determined from asymmetry measurements and the sensitivity of the polarimeter. The polarimeter, based on the Ge(Li) detector, may be used for studying linear polarization of gamma rays which arise in complex nuclear decay schemes. (tr-auth)

17307 (LBL-1523) DISTRIBUTION OF DONORS AND ACCEPTORS IN HIGH-PURITY GERMANIUM CRYSTALS. Haller, E.E.; Hansen, W.L.; Goulding, F.S. (California Univ., Berkeley. Lawrence Berkeley Lab). 5 Dec 1972. Contract W-7405-eng-48. 12p. (CONF-721202-12). Dep. NTIS. From Nuclear Science Symposium; Miami Beach, Florida, United States of America (USA) (6 Dec 1972).

The axial and radial dependence of the net concentrations of donors and acceptors in high-purity germanium was investigated. The methods include dc conductivity measurements on Czochralski-grown crystals, Hall-effect experiments on full area slices, collimated alpha particle probing on detectors, and C-V measurements on detector arrays. Some quantitative correlations between the results of the different methods are presented. Many of the crystals exhibit internal junctions, whose influence on the properties of high-purity germanium detectors are discussed. (auth)

17308 (LUIP-CR-72-13) PHOTOMETRIC TRACK WIDTH-VELOCITY RELATIONS FOR HEAVY IONS IN ILFORD G5 NUCLEAR EMULSIONS. Larsson, L.; Andersson, R.; Mathiesen, O. (Lund Univ. (Sweden). Dept. of Physics). Nov 1972. 24p. Dep. NTIS (U. S. Sales Only).

The relation between the photometrically determined track width, W, and the velocity β of some heavy ions with charge numbers Z = 14, 16, 24 and 26 has been established in Ilford G5 nuclear research emulsions. It has been found that in the velocity interval studied here, $0.40 \leq \beta \leq 0.83$, the relation between W, Z and β can approximately be written $W(\beta,Z) = W_0(Z)\ \beta^{-\alpha(Z)}$. The numerical value of $\alpha(Z)$ is about one. From the empirical

function W(β,Z) its rate of change along the track has been derived. (auth)

17309 (N-72-29823) INSTRUMENT REPORT: PLANETARY X-RAY EXPERIMENT. Anderson, K. A. (California Univ., Berkeley. Space Sciences Lab.). 28 Jan 1972. 100p. (NASA-CR-127798). NTIS.

Design studies for an x-ray experiment to investigate planetary magnetospheres using solid state detectors, or proportional counters are reported. The detectors, background counting rate, and leakage fluxes are discussed. It is concluded that the best choice of instruments appears to be two separate multiproportional counters for redundancy. (STAR)

17310 (ORO-2843-22) DEVELOPMENT AND APPLICATIONS OF THIN FILM DETECTORS. Progress Report, January 1–December 31, 1972. Muga, M. L. (Florida Univ., Gainesville). 1972. Contract AT(40-1)-2843. 53p. Dep. NTIS.

Topics include the response of thin scintillation film detectors to light and heavy ions; double valued dependence of specific luminescence on ion stopping power; thin film detector response to accelerated heavy ions; response of thin film detector to selected fission fragment mass groups; emission at acute angles of light charged particles in fission decay of ^{252}Cf; and response of TFD to fission fragments from proton-induced fission of ^{232}Th. (WHK)

17311 (RISO-249(Pt.2), pp 709-717) NEW TYPE OF HIGH-SENSITIVE AND SOIL-INSENSITIVE RPL GLASS DOSIMETRY. Yokota, R.; Muto, Y.; Koshiro, Y.; Sugawara, H. (Toshiba Research and Development Center, Kawasaki, Japan). Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

An N_2 gas laser light source and delay time readout circuits are described which separate the RPL luminescence from the luminescence from the unexposed dosimeter and from soil on the dosimeter. The decay time for the visible luminescence, which is a measure of the absorbed dose, is ten times longer than the decay times of both the unexposed low-Z silver-activated phosphate glass luminescence and the organic contamination luminescence. By using a low cost ultra-violet N_2 gas laser, an exposure dose of 1 mR can be measured. The fluctuation of the output of the laser is cancelled. (auth)

17312 COMPUTERIZED SCINTILLATION DATA SYSTEM FOR THE γ CAMERA. Jahns, M. F.; Garza, A. L.; Haynie, T. P. (Univ. of Texas, Houston). Comput. Biol. Med.; 2: No. 3, 251-256(Nov 1972).

A computerized scintillation data system for collecting, storing, manipulating, and displaying data obtained by a γ camera is described, and its operation in a hospital radioisotope laboratory is reviewed. Results of clinical application of the system in image subtraction for pancreas visualization and in a dynamic study of kidney function are presented. The instrument shows considerable potential usefulness as an aid to the collection and analysis of clinical data. (auth)

17313 SOLID NUCLEAR PARTICLE DETECTORS: TRACK TECHNIQUE. Dejehet, F. (Univ., Louvain, Belg.). Rev. Quest. Sci.; 143: No. 4, 545-62(1972). (In French).

When a heavy charged particle penetrates into a dielectric solid, it creates, by ionization, a permanent zone of damage susceptible to preferential chemical attack which can be observed microscopically. The counting and the examination of the morphology of the tracks make it possible to deduce a large number of data on the ionizing particle. Thus solid detectors find numerous applications in very diverse areas such as nuclear physics, chemical analysis, dosimetry of radiations, geochronology, and astrophysics. Also, tracks in extraterrestrial rocks and minerals offer interesting possibilities for the improvement of our knowledge of the universe. (tr-auth)

17314 GAS-FILLED IONIZATION COUNTER. Perelman, S. M.; Petrenko, E. E.; Prager, I. A.; Timofeev, A. A.; Tolmachev, A. F. (to Moskovsky Zavod Elektrovakuumnykh Priborov). U. S. Patent 3,710,166. 9 Jan 1973. Filed 15 Jan 1970.

A gas-filled ionization counter in which the cathode and anode are placed in an envelope filled with a gaseous mixture and form the main gas-discharge gap and which has a performance check facility is described. The facility comprises electrodes placed in the gaseous mixture of the envelope and forming an auxiliary gap, and a radioactive source of specified activity, placed in the auxiliary gap so that its own radiation induces a gas discharge solely in the auxiliary gap. This provides a check on the stability of the counter's characteristics in service. (Official Gazette)

17315 IONIZATION RADIATION DETECTOR SYSTEM FOR DETERMINING POSITION OF THE RADIATION. Allemand, R.; Brey, C.; Jacob, J. (to Commissariat a l'Energie Atomique). U. S. Patent 3,703,638. 21 Nov 1972. Priority date 23 May 1969, France.

An x- and γ-radiation detector including a plurality of detecting cells is described. Each cell comprises an anode and two half-cathodes, the half-cathodes consisting of flat plates. The respective half-cathodes are arranged as orthogonal elements so that by applying a matrix technique the output of a particular cell can be selected to localize the radiation detected. (Official Gazette)

17316 INVESTIGATION OF THE SHAPE OF X-RAY NANOSECOND PULSES. Gorbachev, V. M.; Gorbunov, V. V.; Korolev, V. N.; Kuryakin, V. F. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 893-895(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 232-234(1972).

A procedure is described and the results are given for measurements of the length of short x-ray pulses by means of equipment having high time resolution. The radiation detector was a photomultiplier having a toroidal system of dynodes that ensures the time resolution (pulse width at the half-height) of 3 to 3.5 nsec at an output current of up to 5A. The length of the pulses for two types of x-ray tubes is 1.2 to 1.3 and 1.4 to 1.9 nsec. The appearance of second radiation peaks is noted. (auth)

17317 NEW TECHNIQUES FOR DOSIMETRY. On the Application of Solid State Track Detector to Alpha Track Monitor in Uranium Mine. Kurosawa, R. (Waseda Univ., Tokyo). Hoken Butsuri; 7: No. 2, 105-111(Jun 1972). (In Japanese).

Alpha track monitoring with solid state track detectors (SSTD) is described, which is one method of measuring average concentration of α-emitters in the environment of uranium mines. The majority of the α-emitters in uranium mine air consists of ^{222}Rn, ^{218}Po, and ^{214}Po. Since there are many α-emitters in the form of uranium ore in the mines, the detector holder itself is contaminated and influenced by them. There seems to be no better way to avoid the influence than to select an appropriate mounting position for the holder. It has been found that SSTD is practical enough for personal monitors in uranium mines if applied properly. It will require more time for the method to become established as a field monitor system because some problems must be solved, such as the manufacturing of the detectors, simple calibration methods, and track counting methods. (JA)

17318 MECHANISM FOR THE FORMATION OF THE PLATEAU OF THE COUNTING CHARACTERISTIC OF A SCINTILLATION COUNTER. Kibal'chich, G. A.; Tsirlin, Yu. A. (All-Union Scientific-Research Inst. of Single Crystals, Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 837-839(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 188-189(1972).

Equations for the counting characteristics are obtained, as well as the dependence of the relative slope of the plateau on various factors. It is shown that the principal mechanism of plateau formation is "stretching" of the differential distribution along the amplitude axis and "contraction" of this distribution along the axis of counting rates. The determining factor in the formation of the plateau is the signal-to-noise ratio. (auth)

17319 VARIATION OF CARRIER DRIFT VELOCITY WITH ELECTRIC FIELD IN COAXIAL Ge(Li) DETECTORS. Poenaru, D. N. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17, No. 8, 921-931(1972).

In the intermediate field range (300 to 3000 V/cm) encountered in practice, the variation of carrier drift velocity with electric field intensity can be approximated by an empirical relationship. In this variable velocity approximation (VVA) one has two parameters derived from zero field mobility and saturation velocity. Another approach called constant velocity approximation (CVA) can be used in order to obtain much simpler relationships for the current and charge pulses. (auth)

17320 OSCILLATING MONITOR FOR FISSILE MATERIAL. Baumann, N. P.; Ahlfeld, C. E. (to United States Atomic Energy Commission). U. S. Patent 3,699,338. 17 Oct 1972. Filed 5 Aug 1971.

A device for monitoring fissile material has a neutron source that oscillates between a location near and a location remote from a neutron detector. The detector is adjacent to suspected fissile material and is shielded by hydrogenous material from the remote location. The detector output is transmitted to analytical instrumentation for determining prompt and delayed neutron count or the phase angle lag between measured neutron flux and the source oscillation. From these determinations, the reactivity of fissile fuel and the concentration of fissile material in deeply subcritical storage facilities can be obtained. (Official Gazette)

17321 CALIBRATION AND PHYSICAL STUDIES OF DETECTORS USED IN RADIOPROTECTION. Bermann, F.; Beslu, P.; Buxerolles, M.; (and others) (CEA, Paris). pp 353-70 of New

Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328

The various CEA and EDF divisions concerned have set up a Working Group (G. T. 5) with responsibility for investigating and standardizing calibration procedures for detectors used in health physics. Procedures relating to calibration, plotting relative spectral sensitivity, and investigating detector response to high dose rates and pulsed radiation are discussed. The principles adopted and the techniques which have been standardized are presented. The problems encountered and the solutions envisaged are discussed. (France)

17322 PERFORMANCE OF AN X-RAY IRRADIATION CENTER FOR CALIBRATING HEALTH PHYSICS EQUIPMENT. Ambrosi, M. (Laboratoire Central de l'Armement, Arcueil, France). pp 389-405 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The Central Weapon Laboratory has been investigating radiation detectors over the last decade. The studies include investigating the energy response of transducers and calibrating detectors (in operational equipment). The various capabilities of the irradiation center are described together with the equipment and techniques used to define the beams in terms of their energy spectra and exposure rate. The Central Weapons Laboratory operates under the conditions of the 10/10/69 National Bureau of Metrology Contract. (France)

17323 DESIGN OF A HIGH RELIABILITY CRITICALITY ACCIDENT DETECTOR. Musyck, E. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.); Desmet, E. pp 423-30 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The Pu laboratories of the Centre d'Etude de l'Energie Nucleaire–BELGONUCLEAIRE association are continuously monitored by a criticality monitoring system. In order to obtain a high degree of operational safety, each working zone is controlled by at least 3 detectors; a general evacuation alarm is actuated if two or more probes are triggered within a 3 second period. If a single probe is triggered it is automatically taken out of service. Ionization chambers were chosen as detectors because of their mechanical rigidity and their relative insensitivity to fluctuations in the power supply voltage; a preamplifier drawing a very small input current and fitted with field effect transistors is used. A ^{14}C labeled methane source was introduced into the ionization chambers in order to produce a small ionization current thus permitting the monitoring to be effected with an autotest device. The various components used to construct the apparatus are studied in detail. Integrated circuits are extensively used. An additional feature of this system is the means of indicating the evacuation path exposing the personnel to the least dose of irradiation. This path is indicated by rotating lights. The first probe to trigger indicates the site of the accident. (France)

17324 SOME CHARACTERISTICS OF THE TRACK REGISTRATION IN DIFFERENT PLASTIC DETECTORS. Enge, W.; Weber, R.; Beaujean, R.; Bartholoma, K. P. (Univ., Kiel). pp 459-74 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Three different plastic detectors were studied: Daicel cellulose nitrate (Japan), Kodak–Pathe cellulose nitrate (France), and the polycarbonate Lexan of General Electric (USA). These detectors were exposed to B and C ions having an energy of 10.2 MeV/nucleon from an accelerator and to cosmic radiation in high altitude balloon flights. The cellulose nitrate detectors were etched at different temperatures (20 to 65°C). The different etching rates are presented as a function of the energy loss experienced by the heavy ions. The Lexan polycarbonate plastic detectors were irradiated with ultraviolet radiation after being exposed to the ions. In this way their sensitivities were improved by a factor of between 4 and 40 (ratio of the track etching rate to the bulk etching rate). The improvements made to the recording characteristics of the detector are discussed. (France)

17325 DESIGN AND CONSTRUCTION OF RADIOPROTECTION MONITORING PANELS FOR REACTORS. Arnaud, R.; Lucas, G.; Nicolo, R. (Etablissements Merlin et Gerin, Grenoble, France). pp 797-816 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Reactor radioprotection necessitates a large number of monitoring points which are often not very accessible. It is preferable to have a single electronic unit receiving the signals from all the detectors. The (TCR) radioprotection monitoring panel developed by the CEA fulfills this requirement. The Phenix reactor, which requires extensive monitoring, uses this facility. Phenix utilizes 40 radioprotection measurement channels involving the detection of signals ranging from ambient gamma radiation levels to the activity of gases and dusts. The TCR equipment situated in an electronics room processes the incoming signals, operates alarm thresholds, and actuates luminous and sound warning systems. A computer monitors the different signals in order to establish the history of incidents and their evolution. A more detailed knowledge of the risks associated with reactors could lead to a reduction in the complexity of the radioprotection equipment in future years. In addition the reduction in the cost of computers enables systems to be envisaged in which the centralization and processing of measurements would be effected by computer. In this case, radioprotection electronics would be reduced to the simple problem of matching the computer and the detector (to which the electronics could be integrated). (France)

17326 ACTIVATED PLASTIC-SCINTILLATOR DETECTORS FOR FAST NEUTRONS. Baroni, E. E.; Viktorov, D. V.; Kulakova, A. F.; Rozman, I. M.; Shoniya, V. M. This paper was summarized in At. Energ. (USSR); 31: No. 5, 508(Nov 1971) as paper No. 538/6234. (In Russian).

Full copy of this paper is held by TIC.

The parameters of the neutron field can be deduced from the counts which were evaluated with the method commonly employed in the case of threshold detectors. The testing program of the detectors consisted of (a) determination of the light output S from the Compton spectrum of scintillations (γ line of ^{65}Zn); (b) activation of the detectors in a flux of neutrons with the energy 14.1 MeV and comparison of the results of the measurements by extrapolating the activities of various nuclides; and (c) checks of the applicability of the extrapolation for the purpose of determining the absolute activity of the admixtures in the plastic scintillators. Suspended admixtures lead to a considerable decrease in the scattering length of the luminescence photons and, hence, to a decrease in S. In order to determine the light flux, a setup was used wherein the photons left the scintillator through its entire surface and were directed onto a photocathode with the aid of a reflective layer situated at a certain distance from the scintillator surface. Consequently, the efficiency of the β particle count was not less than 80% at the minimum discrimination level ϵ for the isotopes considered. Furthermore, it turned out that at a maximum energy $E_{max} > 300$ keV of the β spectrum, the extrapolation of the integral scintillation spectrum can render the accurate value of absolute activity. Samples containing 20% Al_2O_3 and 10% Ga_2O_3 had the greatest sensitivity to neutrons with an energy of 14.1 MeV among the detectors examined. When the irradiation lasted for a time equal to the half-life of the isotope to be measured, a counting rate of 10 pulses/min corresponded to a flux density of 107 and 117 neutrons/cm^2/sec for the first and the second detector, respectively. (auth)

17327 WHOLE-BODY IMAGING AND COUNT PROFILING WITH A MODIFIED ANGER CAMERA. II. IMPLEMENTATION EVALUATION. Cooke, M. B. D.; Kaplan, Ervin (Veterans Administration Hospital, Hines, IL). J. Nucl. Med.; 13: No. 12, 903-907(Dec 1972).

It was demonstrated that the utility of an existing scintillation camera system can be extended to whole-body imaging and count profiling of static distributions of radioisotope by an add-on accessory while retaining the use of existing parallel-hole collimators. Image quality is satisfactory but dependent on good positional linearity within the area of detector used. Selective tuning to improve positional linearity or to extend the region of adequate linearity would increase the resolution or the sensitivity, respectively, in an Anger system. Delay-line cameras with improved position arithmetics may realize better use of the crystal area. Uniformity is improved along the line of scan while in the transverse axis it may be improved by overlap scanning but with the penalty of increased total scan time. (auth)

17328 WHOLE-BODY IMAGING AND COUNT PROFILING WITH A MODIFIED ANGER CAMERA. I. PRINCIPLES AND APPLICATION. Cooke, M. B. D.; Kaplan, Ervin (Veterans Administration Hospital, Hines, IL). J. Nucl. Med.; 13: No. 12, 899-902(Dec 1972).

A technique for generating whole-body images using an accessory developed for use with a regular commercially available Anger camera is described. The system has been shown to give both image and quantitative data of clinical significance. The possibility of extending the system to whole-body tomography is indi-

cated. While some of the details of the system relate specifically to the use of the existing processing facilities of a commercially available camera, the principle and much of the hardware may be applied to any camera instrument in which positional information from the detector is conveniently available in digital or analog form. (auth)

17329 MANUALLY OPERATED SAMPLE CHANGING ELEVATOR AND LIGHT SEALING MECHANISM FOR SCINTILLATION COUNTERS AND THE LIKE. Robinson, D. D. (to Beckman Instruments, Inc.). U. S. Patent 3,710,120. 9 Jan 1973. Filed 28 Oct 1970.

A sample changing and light sealing mechanism is illustrated and described for moving a sample from one vertical plane to another into a counting chamber while maintaining the light integrity within the chamber. Upon movement of the control arm toward a loading position, a cam on said control arm rotates an actuator wheel and arm to raise the elevator table from a counting position to within an elevator passageway and make a light tight seal at the chamber end of the passageway. The actuator wheel is stopped during further movement of the control arm which then opens an outer shutter over the passageway. The actuator wheel is then again rotated to raise the elevator still further so that the sample may be removed and replaced. Movement in the opposite direction reverses the sequence such that the chamber is at all times sealed against ambient light. (Official Gazette)

17330 LIQUID SCINTILLATION COUNTING. Techniques and Applications in Radiation Protection. Gillet, R.; Regibeau, A. (Univ., Louvain, Belgium). J. Belge Radiol.; 54: No. 3, 441-445(1971). (In French).

Methods for counting low-energy beta emitters and the individual and automatic determination of efficiencies are described. Current applications in an ionizing radiation control laboratory are discussed. (auth)

17331 LOW-BACKGROUND BETA COUNTER. Gyonyor, B. (Technical Univ., Budapest). Period. Polytech. Elec. Eng.; 16: No. 2, 99-112(1972).

A transistorized low-background counter made with Geiger–Mueller tubes is described and illustrated with drawings, block diagrams, and curves. The counter was designed specially for determining small amounts of beta activities in biomedical and radiation-protection studies. The four principal components (detectors in shield, anticoincidence circuit, scalers, and power supplies) are described. The anticoincidence circuit involves signal path, background path, gate circuit, and output circuits. A series of background measurements were made with the prototype of the instrument and the results obtained are discussed. A background of 1.07 ± 0.1 ppM was measured. (JPRS)

17332 CdTe NUCLEAR RADIATION DETECTORS. Chwaszczewska, J.; Dabrowski, A.; Lechowicz, T.; Giriat, W. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 17: No. 7/8, 421-424(1972). (In Russian).

Nuclear radiation detectors based on home made cadmium telluride were developed and fabricated. Surface barrier technology was applied for preparing the junction. The current-voltage characteristics and the response to monoenergetic alpha particles and gamma radiation were measured. (auth)

17333 IMPROVEMENT OF THE PLATEAU CHARACTERISTICS OF A LOW BACKGROUND END-WINDOW TYPE GM COUNTER BY INTRODUCING A CORRECTING RING. Aoyama, T. (Nagoya Univ.); Koike, J.; Maeda, Y.; Watanabe, T. Radioisotopes (Tokyo); 21: No. 12, 693-698(Dec 1972). (In Japanese).

A low background end window type GM counter with a short anode wire of 1.1 cm length was constructed and filled with counting gas which was 89.4% helium and 10.6% isobutane. The gas pressure was about 80 ~ 150 mm Hg. The plateau characteristic was measured by introducing a β-ray beam from a ^{137}Cs source through the center of the window and parallel to the anode wire. The plateau had a large slope. Although there could be some reasons for the slope, considering the short anode wire and the low gas pressure which result in a few ionizing events in the counting volume, it was assumed that the large slope would be due to the decreasing of the counting loss based on the increasing of the counting volume along the counter axis with increasing of applied voltage. In order to decrease the variation of the counting volume with applied voltage a correcting ring was inserted at the end of the anode support to make the electric field near the anode wire uniform through the entire length of the wire. As a result, the plateau characteristic was fairly improved and it was shown that the correcting ring was effective in decreasing the dependence of the counting volume on applied voltage. In order to make sure that the electric field was improved by the ring, some experiments were performed. As a result it was found that the correcting ring absorbed electric lines of force which originated near the end of the anode support and made the electric field near the anode wire fairly uniform. (auth)

17334 PROPERTIES OF PLASTIC SCINTILLATORS MADE OF POLYSTYRENE WITH AN ADMIXTURE OF TETRAPHENYL TIN. Kamienski, A.; Jankowska, M.; Kuchcinski, A. (Inst. of Nuclear Research, Swierk, Poland). 17: No. 7/8, 389-397(1972). (In Polish).

Results of research concerning the influence of a tetraphenyl tin admixture on the scintillation properties of plastic scintillators made of polystyrene are discussed. The technological problems involved in obtaining tetraphenyl tin and in polymerizing plastic scintillators from polystyrene with tetraphenyl tin admixture are described. The results of measurements pertaining to the dependence of the relative light output sensitivity dose and standardized dose sensitivity on the tetraphenyl tin content in the scintillator for various energies of x rays and gamma radiation are presented. The possibilities of obtaining plastic scintillators from polystyrene with tetraphenyl tin admixture equivalent to air or human tissue are also explored with a view to application in dosimetry of x-rays and gamma radiation. (auth)

Radiation Dosimeters

Refer also to abstracts 17521, 17575, 17588, 17597, 17614, 17658, and 18658.

17335 (AD–742869) STUDY OF THE RADIATION STABILITY AND MEANS OF FABRICATING PLASTIC INSULATING FILMS FOR DOSIMETERS. Final Report, May 1, 1968–July 31, 1971. Salyer, I. O.; Ball, G. L.; Wilken, P. H.; Schwendeman, J. L.; Kirkland, E. V. (Monsanto Research Corp., Dayton, Ohio). Aug 1971. Contract DAHC20-68-C-0127. 103p. (MRC-DA-323). NTIS.

The major objectives of this program were accomplished. A process was developed for the synthesis, work-up, and pelletizing and film blowing of an improved emulsion polystyrene dosimeter material. The process was demonstrated to be reproducible and capable of producing a high quality dosimeter film. Numerous experimental samples were made during the course of this work. The nature of these samples was dictated by Oak Ridge National Laboratory (ORNL) test results and jointly agreed upon by ORNL and MRC at various check points as the work progressed. (auth)

17336 (AD-743172) CERIC/CUPRIC DOSIMETRY: 5 KILORADS TO 50 MEGARADS. Technical Report, September 1967 – December 1970. Bowie, D.R. (Edgewood Arsenal, MD; USA). May 1972. 23p. (EA-TR-4527). NTIS.

The ceric/cupric chemical dosimeter was investigated using cobalt-60 radiation at five concentrations over a dose range of 5 kilorads to 50 megarads. A G-value of 2.17 plus or minus 0.01 was determined for ceric concentrations from 1 to 400 millimolar, with a slightly higher value for 0.20 mM. The yield of 100 and 400 mM solutions is affected by competing reactions, and correction factors must be applied. Spectrophotometric analysis combined with automatic dilution techniques was found to be a convenient and reliable method of analysis. Even under adverse conditions the precision obtained with the system approached that of the Fricke dosimeter. (auth)

17337 (BNWL-SA-4355) THERMOLUMINESCENT DOSIMETRY SYSTEM FOR GAMMA, BETA, AND NEUTRON PERSONNEL EXPOSURE. Haverfield, A. J.; Nichols, L. L.; Endres, G. W. R. (Battelle Pacific Northwest Labs., Richland, Wash). 1972. Contract AT(45-1)-1830. 23p. (CONF-721203-9; SM-167/48). Dep. NTIS.

From Symposium on Neutron Monitoring for Radiation Protection Purposes; Vienna, Austria (11 Dec 1972).

The design and performance of a multiple ^{6}LiF and ^{7}LiF thermoluminescent film badge for personnel dosimetry of beta particles, gamma rays, and neutrons are described. The dosimeter can be used repeatedly with proper annealing and maintains a constant sensitivity. The monitoring system has been in operation at Hanford since January 1972, and problems encountered are discussed. (WHK)

17338 (HASL–270) EVALUATION OF $CaSO_4$: Dy AND $CaSO_4$: Tm TLD FOR MEASUREMENT OF SMALL γ-RAY EXPOSURES. Shambon, Arthur (Health and Safety Lab. (AEC), New York). Dec 1972. 13p. Dep. NTIS.

The thermoluminescent response of $CaSO_4$: Dy, formed into pellets, and exposed to ^{137}Cs γ radiation from 1 to 90 mR is given. The thermoluminescent peaks, fading, energy dependence and linearity of response are examined. Tests were also made with a commercial reader and dosimeters, using $CaSO_4$: Tm powder sealed in glass capillary tubes. The feasibility of using $CaSO_4$

doped with Tm or Dy for environmental exposure is discussed. (auth)

17339 (RD/B/M-2164) NOTES ON THE THIRD INTERNATIONAL CONFERENCE ON LUMINESCENCE DOSIMETRY, RISOE, DENMARK, OCTOBER 11–14, 1971. **Harvey, J. R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs. . Nov 1971. 16p. (CONF-711026-(Notes)).**

Some personal notes are presented on a four day conference at Riso in which many aspects of luminescence phenomena were discussed and particular emphasis was placed on their application to radiation dosimetry. Some of the more important topics are selected for comment. (auth)

17340 (RD/B/N-2444) BERKELEY NUCLEAR LABORATORIES PERSONAL DOSIMETRY SERVICE 1972. Hill, M. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Oct 1972. 64p. Dep. NTIS (U. S. Sales Only).

Improvements have been made in the Personal Dosimetry Service operated from Berkeley Nuclear Laboratories. The main change has been the introduction of a new semi-automatic film badge reader based on a WANG 700C programmable calculator. This instrument has also been utilized wherever possible throughout the whole service, e.g., the thermoluminescent dosimetry (TLD) system, with an increase in efficiency. The types of personal dosemeter employed, namely film badges, fast neutron film badges, lithium fluoride sachets, albedos and criticality lockets, are described and an account is given of the methods used in dose determination. The types of radiation to which these dosemeters respond are indicated and between them a wide range of photon energies, slow, intermediate and fast neutrons, and beta particles are covered. Some historical background is given together with discussion of policy and future developments. The computer-produced radiation records system is described in some detail so that new users can acquaint themselves with the method of getting data into and out of the computer. The presentation of information is in the form of a monthly computer print-out which includes 35 updated dose totals, and current dosemeter readings for each individual. (auth)

17341 (RISO-249(Pt.2)) PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON LUMINESCENCE DOSIMETRY, RISOE, OCTOBER 11–14, 1971. **Mejdahl, V. (ed.) (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec 1971. 456p. (CONF-711026-(Pt.2)).**

Thirty-two papers are presented on the following subjects: properties of TL materials, thermally stimulated exoelectron emission, radiophotoluminescence, and TL in clinical and personnel dosimetry. A separate abstract was prepared for each of the 32 papers. (Denmark)

For abstracts of individual papers see: 17311, and 17342–17372.

17342 (RISO-249(Pt.2), pp 444-460) DOSE RELATIONSHIP, ENERGY RESPONSE, AND RATE DEPENDENCE OF LiF-100, LiF-7, AND $CaSO_4$-Mn FROM 8 keV TO 30 MeV. **Eggermont, G.; Jacobs, R.; Janssens, A.; Segaert, O.; Thielens, G. (Rijksuniversiteit, Ghent). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The energy response, the dose relationship, and the dose rate dependence of commercially available Harshaw LiF-100 ribbons, Con-Rad LiF-7 teflon rods, and Con-Rad $CaSO_4$-Mn teflon rods are investigated within the energy region from 8 keV to 30 MeV. The energy response calculations from different grain sizes are based on the general cavity theory for gamma ray energies from 10 keV to 3 MeV and for electron energies between 10 MeV and 30 MeV. The experimental results obtained with $CaSO_4$-Mn confirm the Burlin theory and the grain size dependence of the TL dosimeter response. The decreased sensitivity of LiF-100 at high electron energies can only partially be explained by the cavity theory. Dose response curves are given for doses ranging from 10 rads to 10^6 rads for LiF-7 for 8.3 keV x rays and cobalt-60 gamma rays and for LiF-100 for cobalt-60 gamma rays and 15.3 MeV electrons. Dose estimation is made by evaluation of the integrated area and the peak value of the glow curve. Variation of supralinearity and saturation is established for the different radiation qualities. The modification of the Con-Rad 5100 reader extending its sensitivity and its possibilities is discussed briefly. (auth)

17343 (RISO-249(Pt.2), pp 461-465) ON THE NON-LINEARITY AND LET EFFECTS OF THE THERMOLUMINESCENCE RESPONSE. **Nakajima, T. (National Inst. of Radiological Sciences, Chiba, Japan). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

A releasing probability change model has been proposed through investigation of the properties of the LiF glow curve. The releasing probability change model for the problems of the thermoluminescence response is mathematically discussed. It is stated that this model can qualitatively explain these problems better than other models. (auth)

17344 (RISO-249(Pt.2), pp 466-479) ON THE SENSITIVITY FACTOR MECHANISM OF SOME THERMOLUMINESCENCE PHOSPHORS. **Nakajima, T. (National Inst. of Radiological Sciences, Chiba, Japan). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The sensitization factor of Mg_2SiO_4(Tb) and LiF is studied. It is found that the factor diminishes with increasing annealing temperature, and is dependent on linear energy transfer of both the previous and test radiations and that the sensitization factor of the sensitized phosphor with radiation of higher LET is greater than the un-sensitized one even in the low dose region of the previous dose. The sensitization factor phenomena of LiF and Mg_2SiO_4 phosphors are caused by the radio-stimulated thermoluminescence of electron and hole capture in the deeper trapping levels. (auth)

17345 (RISO-249(Pt.2), pp 480-489) TSEE RESPONSE OF CERAMIC BeO COVERED WITH DIFFERENT ABSORBERS DURING GAMMA AND X-RAY IRRADIATION. **Rotondi, E.; Suppa, T. (CNEN, Rome). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Owing to the very thin layer involved in the exoemission process, the response of a TSEE detector is greatly influenced by the material used as cover during γ- and x-ray irradiation. A study was conducted on the TSEE response of ceramic BeO covered with materials of different atomic number such as aluminum and gold. For x-rays of 66 keV effective energy, the response with gold cover is 18 times higher than with aluminum. With a gold cover the response to x-rays is much higher than to cobalt gamma. It is also shown that the simultaneous use of two BeO detectors covered with aluminum and gold respectively can be utilized for evaluating the low energy x-ray component in an unknown field of photon radiation. It has been observed that diffusion of the gold in the BeO produces the same effect as when the BeO is covered with a gold layer during irradiation. (auth)

17346 (RISO-249(Pt.2), pp 490-503) LOW TEMPERATURE MONITORING USING THERMOLUMINESCENT MATERIALS. **Jarrett, R. D.; Halliday, J.; Tocci, J. (Army Natick Labs., MA). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Samples of the commercially available thermoluminescent materials were subjected to a screening and evaluation procedure to determine their applicability as dosimeters in the region of −30°C. The results of this study are discussed including calibration data from these materials for gamma irradiations at various temperatures. For example, a sample of TLD-100 in its loose powder form yields values twenty to forty per cent lower when irradiated at −196°C than when irradiated at 25°C. Such results show the potential usefulness of thermoluminescent materials but point to the critical dependence of the calibration function on temperature. A standard procedure for "reading out" thermoluminescent materials is discussed. This procedure involves, among its other features, a ten minute annealing period at 100°C prior to readout. This was found necessary in order to eliminate a number of low energy traps that contribute to spurious results. The potential applicability of certain high dose (in the megarads region) materials from commercial radio-sterilization is discussed. The requirement for a low-temperature dosimetry system is demonstrated and the presently available thermoluminescent materials (both commercially available or those in a developmental stage) are evaluated with respect to their potential for meeting this requirement. (auth)

17347 (RISO-249(Pt.2), pp 504-517) DEPENDENCE OF THE RESPONSE OF LiF TLD 100 POWDER, INCORPORATED IN SILICONE RUBBER, ON GRAIN SIZE. **Bassi, P. (CNEN, Bologna); Busuoli, G.; Cavallini, A.; Lembo, L.; Rimondi, O. Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The response as a function of energy of a detector for electromagnetic radiations made up of LiF TLD 100 powder incorporated in silicone rubber has been calculated and measured. It has been shown that the response is due not only to the atomic composition of LiF, silicone rubber, and the respective percentages by weight; but also to the mean weight diameter of the incorporated powder. Within the errors, the measurements fit the calculations which

show that the crucial parameter is the mean weight diameter of the powder. In practice, if the mean weight diameter of the powder is larger than 70 to 80 μm, the detector has a response almost similar to that of the LiF TLD 100 used alone. (auth)

17348 (RISO–249(Pt.2), pp 518–529) MANUFACTURE OF UNIFORM, EXTREMELY THIN, THERMOLUMINESCENCE DOSIMETERS BY A LIQUID MOULDING TECHNIQUE. **Webb, G. A. M.; Bodin, G. (Teledyne Isotopes, Westwood, NJ).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

A technique is described for preparing uniform thin thermoluminescence dosimeters. It is shown possible to fabricate dosimeters containing 30% by weight phosphor as thin as 15 microns with a standard deviation in weights of only 3.6%. In larger sizes the measured standard deviation of a batch of dosimeters was generally 3 to 4%. The silicone polymer before curing has a viscosity high enough to maintain the phosphor in suspension but low enough to enable it to be poured and moulded easily. After curing it is a tough elastic solid able to withstand readout and 300°C annealing. The optical transmission is nearly 100% and it has a similar refractive index to most common phosphors. The efficiency and minimum detectable doses for different compositions with different phosphors are given. The low specific gravity of the silicone binder enables dosimeters to be made with a lower effective thickness for a given physical thickness. A 20 micron $CaSO_4$: Dy–silicone dosimeter of only 2.1 mg/cm^2 effective thickness is described. (auth)

17349 (RISO–249(Pt.2), pp 530–549) CONSISTENCY OF THE DOSIMETRIC PROPERTIES OF ^{7}LiF IN TEFLON DISCS OVER REPEATED CYCLES OF USE. **Marshall, T. O. (National Radiological Protection Board, Surrey, Eng.); Shaw, K. B.; Mason, E. W.** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

A series of anneal and read-out conditions has been applied to ^{7}LiF in teflon discs in order to determine the feasibility of using this thermoluminescent device as the basis of a personal dosemeter for routine whole-body monitoring. It has been demonstrated with six different read/anneal combinations that, with the discs protected from light, little fading occurs and a sufficiently constant sensitivity and an acceptable background can be maintained over numerous cycles of use for average doses up to 1 rad per cycle. Of the six read/anneal combinations some involved the conventional high plus low temperature anneal conditions but in other combinations these anneals were replaced by high and low temperature holds introduced into the read cycle. It still remains to be demonstrated, however, that the performance observed does not deteriorate under operational conditions. (auth)

17350 (RISO–249(Pt.2), pp 550–560) INFLUENCE OF SIZE OF CaF_2:Mn THERMOLUMINESCENCE DOSIMETERS ON ^{60}Co GAMMA-RAY DOSIMETRY IN EXTENDED MEDIA. **Ehrlich, M. (National Bureau of Standards, Washington, D. C.).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Absorbed-dose distributions were measured in CaF_2: Mn TLD of thicknesses between 0.5 and 3.5 mm, irradiated with an essentially plane-parallel beam of ^{60}Co gamma rays in media of aluminum (homogeneous case), polystyrene, copper, and lead. Change of average absorbed dose with dosimeter thickness was deduced from the dose distribution. Since dosimeter sizes were of the order of secondary-electron ranges, total energy absorption was found to be critically affected by interface effects, which caused a loss of linearity of energy absorbed with dosimeter thickness for polystyrene and lead. A relatively strong asymmetry in the absorbed-dose distributions was found near front and rear interfaces, absorbed dose being ~10 per cent higher in front for polystyrene, and ~15 and ~30 percent lower for copper and lead, respectively. Comparisons of relative experimental values of average absorbed dose for different dosimeter thicknesses with values computed according to Burlin's scheme (which does not consider front-rear asymmetries) were not conclusive for polystyrene and lead, since the assumptions regarding the electron spectrum at the dosimeter site proved to be critical for polystyrene, and the assumptions regarding the photon spectrum were critical for lead. For copper, there was agreement to within the limits of experimental reproducibility. (auth)

17351 (RISO–249(Pt.2), pp 561–572) EXOELECTRONIC PROPERTIES OF Al_2O_3-SOLIDS. **Holzapfel, G. (Physikalisch-Technische Bundesanstalt, Berlin); Chryssou, E.** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Besides BeO-materials, Al_2O_3-solids seem to be appropriate for TSEE dosimetry. The exopassive γ-modification changes continuously to the stable and exoactive α-modification between 800°C and 1200°C. For powder materials as well as for ceramics and single crystals, an intense double glow peak around 450°C is characteristic and may be correlated to electron traps within a thin oxygen-deficient cubic surface layer which is mismatched to the underlying hexagonal bulk material. This peak may be convenient especially for high temperature dosimetry and another double peak around 250°C may be used for ordinary TSEE dosimetry. (auth)

17352 (RISO–249(Pt.2), pp 573–588) CHEMICALLY, THERMALLY, AND RADIATION-INDUCED CHANGES IN THE TSEE CHARACTERISTICS OF CERAMIC BeO. **Gammage, R. B.; Becker, K.; Crase, K. W.; Moreno y Moreno, A. (Oak Ridge National Lab., TN).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Of the materials studied so far at ORNL, some commercial ceramic beryllium oxides (Brush Thermalox 995) exhibited the most promising properties for practical TSEE dosimetry. It has been found that a pronounced TSEE peak at ~325°C in this material is closely associated with the presence of SiO_2 in the emitting surface. The peak can be destroyed and an unusual "self-excitation" effect induced by removal of the SiO_2. Both effects are reversible by restoring the initial SiO_2 concentration in the surface. Heat sensitization (optimum sensitivity is obtained by several hours of preheating at 1400°C) can be related to the phase diagram of the BeO–SiO_2 system, in particular the formation of phenacite (Be_2SiO_4). Of several other potential activators, only Li^+ was shown to have a pronounced effect in increasing the high temperature peaks at ~450 and 550°C. The sensitivity can be optimized at a diffusion temperature of 1000°C. Unlike x, beta and gamma radiation, high doses of heavy particles create semipermanent changes in the TSEE peak ratios. In BeO: Si, bombardment with 10^{10} rad or more of 200 keV deuterons, for example, destroys most of the silicon traps. Annealing at 950°C increases the TSEE peak at ~450°C, which disappears after further annealing at 1400°C. A brief interpretation of these effects is given. (auth)

17353 (RISO–249(Pt.2), pp 589–600) EXOELECTRON DOSIMETRY WITH OXIDE MIXTURES. **Euler, M.; Kriegseis, W.; Scharmann, A. (Univ., Giessen, Ger.).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Results describing the dependence of the thermally stimulated exoelectron emission (TSEE) of BeO on various oxide and silicate admixtures after high temperature pretreatment at 1100°C are reported. The intensity of emission is not affected by low concentrations of MgO, Al_2O_3, or SiO_2, but is reduced by high concentrations. A mixture of BeO + ZnO + 2 SiO_2 was considerably more sensitive than all its components. Although during the heat pretreatment Be_2SiO_4 and Zn_2SiO_4 are formed, the increase of sensitivity is only correlated to the combination of ZnO and BeO. This could be concluded from a comparison of the individual TSEE-curves of the mixture components and was verified by an investigation of the system BeO + ZnO. (auth)

17354 (RISO–249(Pt.2), pp 601–611) LOW-Z ACTIVATED BERYLLIUM OXIDE AS A HIGH SENSITIVE RADIATION DETECTOR IN TSEE DOSIMETRY. **Regulla, D. F.; Drexler, G.; Boros, L. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

In order to avoid unwanted effects in matrix materials doped with high-Z material such as reduction of tissue equivalency, a procedure of activating BeO with low-Z material has been developed. By this new activation technique the flat energy response of the matrix material could be maintained; moreover, a marked gain in sensitivity was attained. For multiple re-use of the detectors, high reproducibility could be achieved by a pre-irradiation treatment based on "oxidation" and "hydration" of the detector surface. Glow curves and sensitization factors achieved with BeO: Li by the new activation technique are presented together with the technology of preparation of the detectors concerning the activation material, the activation procedure, and optimum conditions due to thermal treatment and activation atmosphere. Furthermore, some results on the dosimetric properties of the low-Z activated BeO are presented, i.e. the relation between exposure and total counts, the conditions for dose-independent total output/exposure unit, the detection limits, and the directional and energy dependences. (auth)

17355 (RISO–249(Pt.2), pp 612-621) TSEE DOSIMETRY STUDIES. **Niewiadomski, T. (Institute of Nuclear Physics, Krakow). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

An open window G.M. counter and a proportional counter for TSEE measurements were constructed. The G.M. gas flow counter with 0.1 mm Pt wire operates with a 98% argon and 2% ethanol mixture. It works at 1720 V and gives 0.2 V pulses with 0.3 msec dead time and 40 cpm cold background. Pulses are amplified (50 dB) and integrally counted or the count rate is recorded versus temperature. The counter is operated over a nickel sheet working as a heater, supplied by a controlled power supply giving precise linear heating rates between 0.1 and 5°C/sec and temperatures up to 750°C. The proportional counter is a butane-propane flow counter operating at 4 kV. Its pulses are amplified (70 dB) and recorded similar to those obtained from the G.M. counter. Some dosimetric grade LiF powders were investigated for their TSL and TSEE phenomena. The influence of thermal and chemical treatment was investigated and some similarity with the properties of Mg doped phosphors was found. (auth)

17356 (RISO–249(Pt.2), pp 622-631) OPTICAL STIMULATION OF EXOELECTRON EMISSION. **Kramer, J. (Physikalisch-Technische Bundesanstalt, Brunswick). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Until now only thermal stimulation has been applied to dosimetry with exoelectrons. Although more expensive, optical stimulation has important advantages. It is also of great advantage for analysing the traps and determining the stimulation energies. (auth)

17357 (RISO–249(Pt.2), pp 632-653) CHARACTERISTICS OF SELECTED PHOSPHORS FOR STIMULATED EXOELECTRON EMISSION DOSIMETRY. **Ziemer, P. L.; McArthur, W. C.; McManaman, V. L.; Smith, G. D. (Purdue Univ., Lafayette, IN). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The sensitivity, linearity, reproducibility, fading and emission curve characteristics for thermally stimulated exoelectron emission were studied for reagent grade LiF, and CaF_2 powders. Readout was by means of a windowless proportional counter using an argon–methane gas mixture. Sample heating during readout was accomplished using a linear temperature programmer. A multichannel analyzer operated in the multiscaler mode was used to obtain the emission curves. A mixture of LiF with graphite gave improved precision but sacrificed sensitivity as compared to the pure powder. Pure CaF_2 powder was slightly more sensitive than LiF while a mixture of CaF_2 with graphite again resulted in a decrease in sensitivity. In all cases the sensitivity was effected by heat treatments prior to use. In the case of CaF_2, the emission curve characteristics were altered by such preheating. The responses of the powders as a function of exposure were linear over only limited exposure ranges of up to 700 R for LiF/graphite and up to 300 R for CaF/graphite. Both powders exhibited fading or loss of emission as a function of time after exposure. At room temperature, the fading for LiF was 30% in 6 weeks, while for CaF_2 the decrease was about 25% in 122 hours. (auth)

17358 (RISO–249(Pt.2), pp 654-679) PROBLEMS IN THE USE OF PROPORTIONAL COUNTERS FOR TSEE MEASUREMENTS. **Brown, L. D. (Polytechnic, London). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

It has been found that proportional counters designed for the detection of thermally stimulated exo-electrons must be operated at voltages above the end of the conventional plateau. Under these conditions difficulties have been experienced in eliminating occasional spurious readings. Methods have therefore been developed for producing geometrically stable samples suitable for repeated readout which have enabled some of the factors leading to variations in counter performance to be studied. These include the choice of counting gas, the gas flow dynamics, the counter head design, and the effect of the heating cycle during readout. The reader developed incorporates facilities for the recording and comparison of both thermoluminescent and exo-electron emission curves using a small multichannel analyzer. TLD and TSEE reader heads can be quickly interchanged and samples can be re-irradiated in the reader without being removed from the heater cup. Results reported show that it is desirable to avoid the use of extended anodes in the counter, that photo-electrons released as a result of sample thermoluminescence do not contribute significantly to exo-electron counts, and that the simultaneous emission of several exo-electrons appears to be usual. (auth)

17359 (RISO–249(Pt.2), pp 680-691) TRAPPING CENTERS IN CaF_2:Mn FROM THERMOLUMINESCENCE AND THERMALLY STIMULATED EXOELECTRON EMISSION MEASUREMENTS ON UNDOPED AND Mn DOPED CaF_2 SAMPLES. **Pulte, K. J. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen, Netherlands); Arends, J. Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The trapping centers in CaF_2: 3 mole% Mn powder, which exhibits a single but composite thermoluminescence glow peak, have been investigated. Simultaneous measurements of the thermoluminescence (TL) and thermally stimulated exoelectron emission (TSEE) from this powder were carried out using different post-irradiation annealing temperatures. Special precautions have been taken to prevent the light produced by the gas discharge during the TSEE measurements from interfering with the TL signal. TL and TSEE data from single crystals and powdered samples of undoped CaF_2 and CaF_2 doped with 0.1 and 2 mole% Mn, a chemical analysis of the samples, as well as optical density measurements have provided additional information. The combined results indicate that both electron- and hole traps are present in CaF_2 : 3 mole% Mn. The TL is mainly due to holes trapped at the Mn^{++} ions. The high temperature component of the composite TL glow peak and the TSEE peak are probably due to electrons trapped at trivalent rare earth ions, such as Y^{+++}, Ho^{+++}, Sm^{+++}, and Tm^{+++}. (auth)

17360 (RISO–249(Pt.2), pp 693-708) RPL DOSIMETRY SYSTEM WITH FULLY AUTOMATED DATA EVALUATION. **Dade, M. (Frieseke and Hoepfner GmbH, Erlangen, Ger.); Hoegl, A.; Maushart, R. Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

An RPL dosimetry system is described consisting of a dosimeter and the fully automatic reading device. They have been designed as corresponding units that together enable the useful energy range of the system to be extended down to 15 keV. The dose value is displayed by Nixie tubes in steps of 50 mR up to 100 R, and in steps of 500 mR up to 1000 R. Data printout, including the coded dosimeter number, is done by means of either a typewriter or a tape puncher so that further processing of the measured values by a computer will be possible. The use of a gas-tight sealing protects the glass from dirt and dust so that the cleaning procedure becomes unnecessary. The light output of the UV lamp is stabilized by a compensation circuit. After each measuring cycle the photomultiplier sensitivity is corrected automatically by means of a calibration glass. Thus any long time drift effects are eliminated. The system will evaluate 200 dosimeters per hour with an error of less than 5% + 50 mR. (auth)

17361 (RISO–249(Pt.2), pp 718-726) LASER PULSE EXCITATION OF RADIATION INDUCED PHOTOLUMINESCENCE IN SILVER-ACTIVATED PHOSPHATE GLASSES. **Hillenkamp, F.; Regulla, D. F. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Glass cubes of four different manufacturers (Toshiba, Schott, Leitz, CEC) have been excited with frequency doubled, Q-switched ruby-laser pulses (λ = 347 mm, texc $\approx 2.10^{-8}$ s). A specially designed sample holder and detection head and the use of highly discriminating UV filters completely eliminated laser and other background light. This, along with a very careful cleaning procedure of the glasses, allowed the observation of the complete fluorescence pulse including the first few hundred nanoseconds as distinguished from the results reported by others. The measurement of doses as small as 10 mR is demonstrated and a dose-effect curve for the range of 50 mR to 2R is shown. As compared to the DC evaluation of glass dosimeters the laser pulse evaluation leads to a much less detrimental effect of the regeneration cycles on the non-radiation induced predose. The time decay of the fluorescence of the various glasses is discussed and it is concluded that an approximation of the decay curve by two or more exponential functions does not as yet render any better insight into the processes involved. (auth)

17362 (RISO-249(Pt. 2), pp 727-741) RESPONSE OF RADIOPHOTOLUMINESCENT GLASS TO ^{60}Co γ- AND 10 TO 30 MeV ELECTRON RADIATION. **Westerholm, L.; Hettinger, G. (Univ. of Umea, Sweden). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Toshiba RPL-dosimeters (RD-R1-1) and a Toshiba reader (FGD-6) were used. A washing procedure was developed which reduces the fluorescence of deliberately soiled glass to values characteristic for unsoiled glass. Stabilization can be performed as long as 2 h after irradiation without altering the fluorescence yield. The dependence of the fluorescence yield on temperature during irradiation was found to be less than ±0.1%/°C. A special initial pretreatment (irradiation and repeated heat-treatment with subsequent cooling) was found necessary in order to assure that the sensitivity of the dosimeters would be independent of the number of regenerations. Such pretreated dosimeters have a precision which is approximately a factor of 2 better than those not pretreated. No correlation between sensitivity and the mass of the glass rod was observed. The relationship between fluorescence and absorbed dose in the range of 30 to 800 rads could be approximated by a straight line. Glass dosimeters were absorbed dose-calibrated at different depths in a water phantom which was irradiated with electrons, the incident energy of which was 14, 24 or 31 MeV, or with ^{60}Co γ-radiation. The calibration values were found to be independent of the type of radiation and depth in the phantom. (auth)

17363 (RISO–249(Pt.2), pp 742-755) SOME WAYS OF APPLYING THE CAPABILITIES OF VARIOUS LUMINESCENCE METHODS IN PERSONNEL MONITORING. **Toivonen, M. (Inst. of Radiation Physics, Helsinki). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The principal advantage of RPLD, namely, the possibility of reading its indication repeatedly at arbitrary intervals throughout a period of long-term dose integration, proved to be of no value when used as a measuring technique in a personnel monitoring service. TLD proved more practical in routine measurements, even when powdered luminophors and simple readout arrangements without automation were used. RPLD seems to be more versatile than TLD if information concerning the type of radiation and its incidence is needed in interpreting whole-body or organ doses involving high, abnormal exposures. A development of dosemeter badges is discussed, details of the RPL and TL techniques used are described, and the usefulness of a new general purpose dosemeter approach is assessed in the light of experience gained in film dosimetry practice. Studies of the technique of scanning the RPL distribution in glass blocks are presented and typical results are stated. (auth)

17364 (RISO–249(Pt.2), pp 756-780) RADIATION-INDUCED OPTICAL ABSORPTION AND PHOTOLUMINESCENCE OF LiF POWDER FOR HIGH-LEVEL DOSIMETRY. **Claffy, E. W.; Gorbics, S. G.; Attix, F. H. (Naval Research Lab., Washington, D. C.). Dec 1971.**

From 3rd international conference on luminescence dosimetry; **Risoe, Denmark (11 Oct 1971).**

Undoped LiF powder and the diffuse-reflectance apparatus described form the basis of a nondestructive technique for dosimetry in the 10^5 to 10^8 rad region. The properties determined are optical absorption in the M and R_2 bands and radiophotoluminescence (RPL) of the M centers. From 10^5 to 10^7 rad, M-center RPL is useful; from 10^6 to 10^7 rad, absorption in the M band is applicable; and absorption in the R_2 band from 10^7 to 10^8 rad. The stability of both absorption bands and the M-center RPL as a function of time at room temperature after irradiation is adequate for most practical applications. The lack of linearity in absorption or in the RPL vs. dose necessitates the use of a suitable calibration curve. Absence of measurable dose-rate dependence is indicated by essentially the same response per rad in the LiF for 2-MeV electrons, whether in a Van de Graaff beam depositing 10^4 rad/sec or in a high-intensity 30-ns pulsed beam giving 10^{14} to 10^{15} rad/sec. However, ^{60}Co γ rays and low-energy x rays (≈15 keV) yield 2- or 3-fold greater absorption and RPL than do electrons. This can be characterized either as a difference between the effects of electrons and photons or as an energy dependence, negligible between 15 keV x rays and ^{60}Co γ rays (which produce an equilibrium secondary-electron spectrum of ≈0.3 MeV average energy) but important between 0.3 MeV and 2 MeV. Use of a powder allows the homogenization of large quantities of material for uniform performance, and at reasonable cost for only 15 to 30 mg is needed per dosimeter. Since readout does not disturb stored signals, thermoluminescence can be subsequently measured to verify dose information on a single dosimeter. (auth)

17365 (RISO–249(Pt.2), pp 781-792) TWO YEARS EXPERIENCE OF CLINICAL THERMOLUMINESCENCE DOSIMETRY AT THE RADIUMHEMMET, STOCKHOLM. **Ruden, B. I. (National Inst. of Radiation Protection, Stockholm). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Thermoluminescent dosimeters (TLD) have been used extensively for patient dose measurements at the Radiumhemmet during recent years. About 17,000 clinical measurements were performed during 1970 and two thirds of these were made with TLD. The majority of the dose measurements were performed with dosimeters containing LiF; but $Li_2B_4O_7$: Mn and $CaSO_4$: Mn were also employed. The precision of the dosimeters is within ±2% provided an individual calibration schedule is used. Calibrations have been performed to ascertain the differences in sensitivity for various radiation energies. The conversion of dosimeter reading to absorbed dose in tissue is included in these calibrations. The clinical TLD applications that are discussed include routine measurements for ^{60}Co γ-rays 6 to 42 MV x-rays and 5 to 39 MeV electrons; verification through intracavitary and intravenous measurements of the dose distributions obtained in patients; determination of absorbed dose from beta emitters; and investigation of neutron contamination in the use of high-energy radiation. (auth)

17366 (RISO–249(Pt.2), pp 793-813) THERMOLUMINESCENCE DOSIMETRY FOR CLINICAL USE IN RADIATION THERAPY. **Gooden, D. S. (St. Francis Hospital, Tulsa, OK); Brickner, T. J. Jr. Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

A complete thermoluminescence dosimetry system for use in radiation therapy is presented with a description of new techniques for dosimeter pairing, grouping, calibration, and annealing. TLD-100 High Sensitivity Ribbons are proposed as the dosimeter of choice for routine dosimetry within a radiation therapy facility. The importance of a TL reader with a "two cycle" readout in which the luminescence associated with low temperature peaks is ignored is discussed. This TLD system lends itself well to routine dosimetry of a multitude of treatment techniques in a busy clinical practice. The entire system can be operated by a trained radiation technician. The system is used within our department for external beam dosimetry, intracavitary dosimetry, calibration of treatment cones, experimental set-ups and others. It has shown an accuracy of better than ±2% under experimental conditions, and an estimated clinical accuracy of better than ±4%. (auth)

17367 (RISO–249(Pt.2), pp 814-815) TLD–CALCIUM-FLUORIDE IN NEUTRON DOSIMETRY; TLD–CALCIUM-SULPHATE IN HEALTH PROTECTION SERVICE. **Bewley, D. K.; Blum, E. (Hammersmith Hospital, London). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Calcium-fluoride (Mn)–Teflon TLD has been used for studies of the fast neutron beam from the MRC cyclotron. The very small intrinsic response of this phosphor to fast neutrons makes it suitable for investigating the γ contribution in the field. The response to fast neutrons can be enhanced by surrounding the dosimeters with a hydrogenous material such as polythene. Exposure in pairs, one in polythene and one in lead, makes it possible to measure both γ and neutron components of the radiation field. This method has been applied to depth dose studies in tissue equivalent phantoms. Calcium sulphate (Dy)-Teflon dosimeters in the form of 4 mm × 12 mm discs have been calibrated in the dose range of a few hundred rads, and linear response has been obtained over 5 decades of dose. The high sensitivity and high temperature peak make these dosimeters suitable for personal monitoring. (WHK)

17368 (RISO–249(Pt.2), pp 816-830) LITHIUM FLUORIDE DOSIMETERS IN CLINICAL RADIATION DOSE MEASUREMENTS. **Suntharalingam, N.; Mansfield, C. M. (Thomas Jefferson Univ. Hospital, Philadelphia). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Several types of LiF dosimeters have been used in a wide range of clinical dosimetry applications. The use of loose powder, wherever feasible, gives the highest precision and accuracy (±2%). When using the solid forms of dosimeters, special calibration procedures have to be accommodated in order to achieve a precision of ±3%. In-vivo measurements on patients receiving cobalt-60 radiation therapy by tangential breast fields, Hodgkins-mantle fields, and for tumors in the head and neck area, bladder and esophagus are reported. Patient measurements have been supplemented by measurements with tissue equivalent phantoms. The measured doses have been compared with calculated doses and shown to be in good agreement. (auth)

17369 (RISO–249(Pt.2), pp 831-850) PERSONAL DOSIMETER SYSTEM BASED ON LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETERS (TLD). **Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The system comprises a personal dosimeter, an automatic reader for it, and a semi-automatic reader for finger tip dosimeters. Two TLDs are mounted on a plaque bearing the identity of the wearer as a hole code. One TLD, 0.9 mm thick, registers the penetrating component of radiation and the other, 0.25 mm thick, the skin dose. The reader automatically identifies 200 plaques and measures 400 dosimeters in one and a half hours. These identities and doses are printed and punched on paper tape by a teletype writer. The TLDs are read by heating them with a hot anvil until a thermocouple on the other side of the TLD reaches the temperature for complete readout. The semi-automatic reader measures the dose registered by teflon disc lithium fluoride TLDs. The discs are placed by hand onto a planchet fitted with a ring whose diameter is just right to keep the TLD flat during heating. Energy dependence results for the TLDs for gamma and beta rays are given. Data on linearity, reproducibility and the effect of cycling TLDs through the reader are also presented. (auth)

17370 (RISO–249(Pt.2), pp 851-863) PROGRESS TOWARDS AUTOMATIC TLD PROCESSING FOR LARGE-SCALE ROUTINE MONITORING AT RISOE. **Boetter-Jensen, L.; Christensen, P. (Danish Atomic Energy Commission, Risoe).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

A TL dosimeter unit (badge) was designed to facilitate automatic processing. The badge, which is made of heat-resistant plastic material and covered with 1 mm Al shielding, contains four dosimeters and a binary identification code. Three dosimeters are read in an automatic procedure and the fourth is retained for manual read-out in case of failure. The dosimeter badge is used as standard unit for several dosimetry purposes including personal and environmental monitoring. A major component of the overall system is an automatic reader which accepts a stack of TLD badges, reads the identification number and lifts the TLD from the badges into a read-out chamber where they are heated by hot nitrogen gas. The badge-unit was adapted for personal β-γ-monitoring by unshielding one of the four dosimeters. Results are presented from investigations of a personal monitoring system consisting of two Lithium borate dosimeters for routine β-γ-monitoring and one Lithium-7-fluoride dosimeter intended for long-term monitoring and back-up in the case of exposures to thermal neutrons. The investigations include dosimeter response to neutrons α, β, and γ radiation of different energies. (auth)

17371 (RISO–249(Pt.2), pp 864-878) UV INDUCED THERMOLUMINESCENCE IN NATURAL CALCIUM FLUORIDE. **Okuno, E. (Univ., Sao Paulo, Brazil); Watanabe, S.** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Samples of a green variety of fluorite found at Criciuma, Brazil, annealed at 580°C for 10 minutes and then at 400°C for two hours were exposed to 365 nm UV light. The transferred TL from deep trap to lower temperature trap gives rise to a glow curve containing peaks I, II, III', III and IV in a readout up to 400°C. This TL response was measured as a function of UV exposure time t and the result is not a saturation curve, but TL tends to zero for large t indicating a simultaneous bleaching effect. The curve of TL vs. the number n of identical cycles in an exposure readout cycle was obtained for different durations of exposure in each cycle, showing that for large n the rate of decrease of log (TL) is independent of the exposure duration. The effect of duration and temperature of pre-annealing on TL transfer under UV exposure as well as the dependence of transferred TL on previous gamma radiation were investigated. Finally a mathematical model is proposed. (auth)

17372 (RISO–249(Pt.2), pp 879) CURRENT LOOK AT TLD IN PERSONNEL MONITORING. **Attix, F. H. (Naval Research Lab., Washington, D. C.).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Information obtained through a questionnaire, sent to 140 establishments of various types in 26 countries, is discussed. One hundred five completed forms were returned for evaluation, reporting on the monitoring of some 200,000 persons by badges of various kinds. Roughly one-third of the establishments now include TLD's as part of the badge, covering 65,000 employees. However only 14 institutions and 15,000 employees use TLD's for record keeping purposes in place of film. Within the next 3 years 25 more institutions (41,000 employees) plan to adopt TLD's.and 18 establishments (50,000 employees) plan to use them in place of film for record keeping of $\beta\gamma$ radiation exposures. TLD with LiF chips or Teflon discs is now the method of choice for extremity monitoring, being so used by 57 establishments. Forty-six use TLD's for area monitoring and 19 for measuring patient exposure. Only 21 are not now using TLD at all in some radiation protection application. (WHK)

17373 (RISO–249(Pt.3)) PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON LUMINESCENCE DOSIMETRY, RISOE, OCTOBER 11–14, 1971. **Mejdahl, V. (ed.) (Danish Atomic Energy Commission, Risoe, Research Establishment).** Dec 1971. 350p. (CONF-711026–(Pt.3)).

Twenty-two papers are presented arranged according to the following subjects: dating and background radiation monitoring; charged particle, neutron and uv response, and miscellaneous properties, effects and applications. A separate abstract was prepared for each of the 22 papers. (Denmark)

For abstracts of individual papers see: 17283–17286, and 17374–17391.

17374 (RISO–249(Pt.3), pp 960-984) ENVIRONMENTAL AND PERSONNEL DOSIMETRY IN TROPICAL COUNTRIES. **Becker, K.; Lu, R. H.-W.; Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Personnel dosimetry and long-term measurements of background radiation usually cannot be carried out with satisfactory precision under tropical climate conditions with photographic films. This is mainly due to accelerated fading at frequently high humidity and/or temperature, and can be countered or avoided by the use of properly selected solid-state detectors. In addition to extensive field tests at 23 to 32°C and 75 to 95% relative humidity with track and ordinary photographic films and various TLD detectors in Taiwan, laboratory fading experiments were carried out in the 25 to 150°C temperature range with LiF : Mg, T, $CaSO_4$: Dy, $CaSO_4$: Tm, CaF_2 : Mn, and CaF_2 : Dy TLD materials. It is concluded that $CaSO_4$: Tm and $CaSO_4$: Dy powders, which combine high sensitivity and stability, are most suitable for TLD background radiation measurements with a precision of about ± 0.2 to 0.5 mR, while encapsulated LiF : Mg, Ti or BeO : Na could be used in personnel dosimetry. Ceramic BeO : Si is most promising for environmental or personnel TSEE dosimetry. (auth)

17375 (RISO–249(Pt.3), pp 985-1001) NATURAL RADIATION BACKGROUND DOSE MEASUREMENTS WITH CaF_2:Dy TLD. **Jones, D. E.; Lindeken, C. L.; McMillen, R. E. (Univ. of California, Livermore).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Four quarterly and one monthly integrated environmental dose measurements were made with CaF_2 : Dy TLD's in approximately 100 homes of LLL employees and at selected out-of-doors locations. Another project is a nearly uniform geographic sampling of background dose in the 50 United States. These data are particularly interesting since they represent simultaneous integrated measurements with uniform geometry. The quarterly data also represent the average seasonal dose rates for specific locations in the Livermore Area. At the median exposure (9.6 mR) from the quarterly home data, the individual values have a standard deviation of ± 5%. These data are summarized and the technique and methods for overcoming phosphor limitations are emphasized. This technique for natural background dose measurements is reliable and relatively inexpensive. The major accuracy limitation is proper recognition and handling of potential nonrandom errors. These include factors such as fading and energy dependence. The phosphor response to cosmic radiation is under study as a potential source of error in TLD environmental measurements. The study was started when results were compared with the data from other techniques. The comparison was inconclusive in elucidating the response. Preliminary results are shown for response to cosmic radiation and high energy protons and alpha particles. (auth)

17376 (RISO–249(Pt.3), pp 1002-1014) IMPURITIES AND THERMOLUMINESCENCE IN LITHIUM FLUORIDE. **Rossiter, M. J.; Rees-Evans, D. B.; Ellis, S. C. (National Physical Lab., Teddington, Eng.).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Single crystals of lithium fluoride were grown with additions of magnesium and titanium. The distribution of these impurities along the crystal was studied and correlated with the radiothermoluminescence (TL) and optical absorption properties. The addition of magnesium alone yields material with a main

glow peak near 200°C; the TL sensitivity depends greatly on the purity of the lithium fluoride used. Whereas the magnesium is found to be uniformly distributed along the growth axis of the crystal, the TL sensitivity is not constant. This variation of sensitivity initially parallels the distribution of titanium when it is present in addition to magnesium. At the higher titanium levels studied, concentration-quenching of TL is observed. The intensity of an optical absorption band near 200 nm in the unirradiated crystal is found to be proportional to titanium content, but the radiation-induced absorption is unrelated to titanium. These results are considered to provide strong evidence that titanium functions as the luminescence center in TL lithium fluoride. (auth)

17377 (RISO–249(Pt.3), pp 1015-1030) MEASUREMENT OF DOSE FROM A PLANE ALPHA SOURCE. **Harvey, J. R.; Townsend, S. (Central Electricity Generating Board, Berkeley, Eng.).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

In order to check theoretical predictions of the dose to the basal layer of the epidermis from alpha active material near the skin surface, finely ground thermoluminescent lithium fluoride was used to measure the microstructure of dose from a plane source of alpha radiation. Since it is difficult to fabricate very thin layers of LiF, a difference method was employed in which dose was assessed from measurements made behind various thicknesses of melinex foil. The LiF was calibrated by irradiation with alpha particles in vacuum. The results help explain the variation of sensitivity of LiF with LET, the correctness of the present estimates of the range of alpha particles in solids, and the theoretical model used for predicting alpha dose. (auth)

17378 (RISO–249(Pt.3), pp 1031-1039) THERMOLUMINESCENT RESEARCH OF PROTONS AND ALPHA-PARTICLES WITH LiF (TLD-700). **Jaehnert, B. (Hahn-Meitner-Institut fuer Kernforschung, Berlin).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Thermoluminescent dosimeters of LiF (TLD–700 powder) were irradiated with alpha particles in the energy range 1.7 to 3.7 MeV and with protons in the energy range 2.4 to 13.3 MeV. The readout heating rate was 35°C/sec. A nitrogen atmosphere was used. For each kind of irradiation the glow-curve and the integral thermoluminescent response were compared with ^{60}Co-gamma irradiations. The beginning of supralinearity was observed for alpha irradiation at $2 \cdot 10^3$ rads; for gamma irradiation it was at 500 rads. The thermoluminescent response depends on the LET of the radiation. The response was normalized to that for ^{60}Co-gamma rays. For protons the TL response was found to be 87% for 13.3 MeV and 58% for 3.7 MeV protons. For alpha particles in the energy range 1.7 to 3.7 MeV the average response was 16%. To fit the experimental data a mathematical experiment was made which describes the processes during irradiation and read-out. (auth)

17379 (RISO–249(Pt.3), pp 1040-1050) THERMAL NEUTRON DOSIMETRY BY PHOSPHOR ACTIVATION. **Mayhugh, M. R.; Watanabe, S.; Muccillo, R. (Instituto de Energia Atomica, Sao Paulo, Brazil).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Three common thermoluminescent phosphors, $CaSO_4$: Dy, CaF_2: Dy, and CaF_2: natural, were examined to determine the feasibility of their application in thermal neutron dosimetry. Basically, the phosphor is exposed to thermal neutrons (and other radiations) causing activation of nuclei in the phosphor. Next, the phosphor is stored to undergo self-irradiation from the internal radioactive nuclei, in this case all beta emitters. Later the thermoluminescence induced by the beta emission during storage is read. This reading depends on the original neutron exposure, and could thus provide a dosimetry system. The phosphors contain isotopes, ^{44}Ca or ^{164}Dy (and ^{34}S). Limits for the lowest detectable fluence were determined by extrapolating results from high fluence measurements. Using the decay of ^{165}Dy (2.3 h half-life) the lowest detectable fluence is estimated to be 5×10^7 n/cm^2. Using ^{45}Ca decay (165 d half-life), this limit is raised to about 5×10^{10} n/cm^2. Methods for improvement are discussed. (auth)

17380 (RISO–249(Pt.3), pp 1051-1062) DETERMINATION OF THE SENSITIVITY OF THE CaF_2:Mn THERMOLUMINESCENT DOSIMETER TO NEUTRONS. **Prokic, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

In a mixed (n + γ) radiation field, intensive neutron radiation may cause difficulties in assessment of the gamma dose. The sensitivity of the CaF_2: Mn thermoluminescent gamma dosimeter to fast, fission, intermediate, and thermal neutrons was studied. The magnitudes of the mentioned sensitivities were determined by first collision dose calculations in CaF_2: Mn. The relative thermoluminescent response as a function of LET for neutrons of different energies permits determination of the CaF_2: Mn thermoluminescent sensitivity to neutrons in terms of equivalent ^{60}Co R per 10^{10} n/cm^2. An experimental check of the calculated sensitivity values was performed, irradiating hot-pressed CaF_2: Mn powder (TLD-08, IJS) in different types of neutron fluxes. (auth)

17381 (RISO–249(Pt.3), pp 1063-1073) TRIPLET EXCITON ANNIHILATION FLUORESCENCE CHANGES INDUCED BY FAST NEUTRON RADIATION DAMAGE IN ANTHRACENE. **Pearson, D.; Moran, P. R.; Cameron, J. R. (Univ. of Wisconsin, Madison).** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The triplet exciton annihilation fluorescence (delayed fluorescence) of anthracene crystals is known to be sensitive to radiation damage. The investigations were primarily related to annihilation fluorescence changes induced by fast neutron irradiation. The three factors that determine the fluorescence behavior are the optical production efficiency of the triplet excitons, the biomolecular annihilation coefficient, γ, and the fluorescence monomolecular decay rate, β. Using flashlamp excitation it was found that β is directly proportional to the absorbed dose $R: \beta(R) = \beta_0 + aR$. The proportionality constant, a, was determined for 14 MeV neutrons, 2.5 MeV neutrons, 30 keV effective X-rays, and 662 keV γ-rays. Typically β_0 is about 100 sec^{-1}, and both β_0 and a vary somewhat with sample batch of the anthracene. A discussion is presented on how these sample quality dependences limit the reliable sensitivity to about 10 rads for measuring the annihilation fluorescence changes at room temperature. The total steady state blue fluorescence yield F_r, for controlled red light excitation, was also measured. At low excitation light levels it was found that the fluorescence decreases with radiation dose according to the form $[F_r(O)/F_r(R)]^{\frac{1}{2}} = (a/\beta_0)R + 1$. From this behavior it was concluded that only the decay constant β is strongly affected by the radiation damage. At room temperature the observed damage effects appear to be stable with fading rates certainly less than 5% per month. (auth)

17382 (RISO–249(Pt.3), pp 1074-1088) MIXED NEUTRON–GAMMA DOSIMETRY. **Dua, S. K. (CEN, Mol, Belgium); Boulenger, R.; Ghoos, L.; Mertens, E.** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Studies on the measurement of mixed neutron-gamma doses were made using CaF_2: Mn discs, $CaSO_4$: Mn, LiF-6, and LiF-7 microrods from ISOTOPES/CONRAD and TLD-100 and TLD-700 microrods from Harshaw Chemical Company. The dosimeters were irradiated at thermal neutron fluences varying from 10^7 to 10^{14}n cm^{-2}. The cadmium ratios at the points of irradiation were more than 100. The gamma doses were measured by shielding the dosimeters with ^{6}Li or ^{10}B. The thermal neutron response of a given dosimeter depends on the abundance of the thermal neutron sensitive element in it. LiF-6 dosimeters which are suitable for the measurement of low thermal neutron fluences showed a decrease in response at high fluences of about 10^{12} n cm^{-2}. They also showed memory effects at thermal neutron fluences of about 10^{10} n cm^{-2}. Change in color of LiF-6 and TLD-100 was also observed at about 10^{13} n cm^{-2}. By partly covering the planchet of the commercial TLD reader, higher temperatures required for neutron dosimetry could be reached without increasing the background contribution from the planchet. Glow curves from samples irradiated with ^{60}Co and neutron-gamma radiations are also presented. (auth)

17383 (RISO–249(Pt.3), pp 1089-1106) ENERGY RESPONSE OF CERTAIN THERMOLUMINESCENT DOSIMETERS AND THEIR APPLICATION TO THE DOSE MEASUREMENTS. **Pendurkar, H. K. (CEN, Mol, Belgium); Boulenger, R.; Ghoos, L.; Nicasi, W.; Mertens, E.** Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The energy dependence of some commercially available thermoluminescent LiF, $Li_2B_4O_7$: Mn, and CaF_2: Mn dosimeters was investigated over the X- and γ-ray energy range from 8 keV to 1.25 MeV with a particular interest in the low energy region below 50 keV. The radiation sources included monochromatic fluorescent radiations from different target materials, heavily filtered X-ray beams from 10 kV to 280

kV exciting potentials, and γ-ray energies from ^{137}Cs, ^{226}Ra, and ^{60}Co sources. The dosimeters used were in the form of microrods, extruded ribbons, and discs. The experimental response is compared with the calculated energy response of these dosimeters. The determination of mean energy below 50 keV was done by using the scintillation spectrometry method. The response of LiF-Teflon discs and LiF extruded ribbons to beta rays was also investigated using beta ray emitters (e.g., ^{185}W, ^{204}Tl, ^{89}Sr, $^{90}Sr-^{90}Y$, and ^{106}Rh) in the energy range 0.43 to 3.54 MeV. The application of LiF-Teflon disc dosimeters in the estimation of dose to finger tips while handling radioactive material in laboratory work was studied, and the use of $Li_2B_4O_7$: Mn-Teflon microcards in the determination of exposure was examined. (auth)

17384 (RISO-249(Pt.3), pp 1107-1117) Tm-AND-Dy-ACTIVATED $CaSO_4$ PHOSPHORS FOR UV DOSIMETRY. **Nambi, K. S. V.; Higashimura, T. (Kyoto Univ.). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

A simple and sensitive method of measuring integrated UV irradiances using the thermoluminescent properties of Tm- and Ty-activated $CaSO_4$ phosphors is presented. The two phosphors behave almost identically, and results are presented for a typical case of $CaSO_4$: Tm. A high temperature peak (at ~450°C) is created by heavy gamma-irradiation of the phosphor which is then annealed in such a way that the dose remains as residual thermoluminescence (RTL) in the sample. Such a phosphor when exposed to UV light (especially 253.6 nm photons) and subsequently heated produces the usual dosimetric peak at ~200°C with a slight depletion in the RTL. The creation of this dosimetric peak was found to be linearly proportional (on a log-log plot) to the UV irradiances in the range of about 1 to 1000 $\mu W \cdot sec \cdot cm^{-2}$ at 253.6 nm and is independent of dose rate. Other important dosimetric characteristics such as photon energy dependence, re-usability of the phosphors, etc., are also discussed. (auth)

17385 (RISO-249(Pt.3), pp 1118-1121) TRANSFERRED THERMOLUMINESCENCE IN CaF_2:nat AS A DOSIMETER OF BIOMEDICALLY INTERESTING ULTRAVIOLET RADIATION. **McCullough, E. C.; Fullerton, G. D.; Cameron, J. R. (Univ. of Wisconsin, Madison). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The annealing and pre-irradiation treatment and the sensitivity of natural CaF_2 for uv dosimetry are described. The primary objective of the research was to develop a uv dosimeter whose spectral response approximates the erythema action spectrum of human skin. (WHK)

17386 (RISO-249(Pt.3), pp 1123-1154) STORAGE STABILITY OF TL AND TSEE FROM SIX DOSIMETRY PHOSPHORS. **Nash, A. E.; Ritz, V. H.; Attix, F. H. (Naval Research Lab., Washington, D. C.). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The thermally stimulated exoelectron emission (TSEE) and thermoluminescence (TL) signals resulting from β-irradiation were simultaneously measured for each of six dosimetry phosphors: LiF(TLD-100), CaF_2: Mn, CaF_2 (fluorite), $Li_2B_4O_7$: Mn, and $CaSO_4$: Mn (all in powder form), and BeO-998 sintered discs. The samples were initially annealed for 1 hr at 400°C (600°C for BeO), then either irradiated and read out promptly, or irradiated and read out after storage, or stored and then irradiated and read out. Storage was in the dark at room temperature in either dry air or argon, for 1 week or 1 month. Some additional samples were stored in air at 100% humidity. Results are presented and discussed. In general TL signals show greater time stability than TSEE. BeO seems to offer most advantages as a TSEE dosimeter of the materials studied. (auth)

17387 (RISO-249(Pt.3), pp 1155-1162) OPTICAL ABSORPTION AND ESR PROPERTIES OF THERMOLUMINESCENT NATURAL CaF_2 AFTER HEAVY GAMMA IRRADIATION. **Nambi, K. S. V.; Higashimura, T. (Kyoto Univ.). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Studies were made on the optical absorption and ESR of TLD grade natural CaF_2 after heavy irradiation with Co-60 gamma rays in the range 10^5 to 10^9R at room temperature. Though none of the original thermoluminescence characteristics of the phosphor change after such heavy irradiations, new optical absorption bands were observed at about 950, 1150, and 1350 nm successively as irradiations were continued from ten to one thousand megarads. Preliminary investigations indicate the formation of colloidal type centers in CaF_2 by heavy irradiations giving rise to such near-infrared absorption bands. ESR studies with this CaF_2 powder resulted in the identification of three distinct signals: (1) signal P which has maximum intensity when there is no trace of TL present in the sample; (2) signal S which is irradiation-produced, and whose build-up and decay are observed to be complementary to the depletion and recovery respectively of signal P; and (3) a sharp doublet signal H separated by 501.25 G which saturates faster with microwave power. Arguments are presented to identify signal P with paramagnetic RE^{3+} centers, signal S with either hole centers or paramagnetic RE^{2+} centers, and signal H with trapped hydrogen atoms in the CaF_2 lattice. (auth)

17388 (RISO-249(Pt.3), pp 1163-1176) METHODOLOGICAL ASPECTS ON MEASUREMENTS OF STEEP DOSE GRADIENTS AT INTERFACES BETWEEN TWO DIFFERENT MEDIA BY MEANS OF THERMOLUMINESCENT LiF. **Carlsson, G. A.; Carlsson, C. A. (Univ. of Linkoeping, Sweden). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

0.1 mm thick LiF-detectors were used for dose measurements in a low Z-material irradiated with 100 to 200 kV X-rays adjacent to different high Z-materials. The detectors were thin for the photon radiation, but infinitely thick for the electrons generated in the high Z-material. In the transition region, i.e., within the range of the most energetic electrons generated in the high Z-material, the dose distribution was derived by interposing a varying number of mylar films between detector and the high Z-material. The dose in these experiments varied heavily with depth in the detector, so that induced and inherent efficiency variations with depth in the detector must be considered. Evidence of a dead surface layer of LiF was observed. (auth)

17389 (RISO-249(Pt.3), pp 1177-1192) KAPIS AS A THERMOLUMINESCENT DOSIMETER. **Bustamante, N. T.; Petel, R.; Bartolome, Z. M. (Philippine Atomic Research Center, Quezon City). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

Naturally occurring kapis shells (Placuna placenta Linnaeus) were studied as possible thermoluminescent dosimeters. They grow in muddy, blackish waters from the shallow coasts to depths of 20 fathoms. Chemical analysis showed the composition to be essentially $CaCO_3$. The kapis shells were cut into small discs (6 mm dia.), and the response to different sources like ^{60}Co, ^{226}Ra, and X-rays of various energies were determined. The response to ^{60}Co and ^{226}Ra was linear from 50 to 10^4R with a precision of ±10%. The response to low-energy X-rays was higher than the response to ^{60}Co, which showed the energy dependence of the kapis. However, the precision was lower mainly because of the heterogeneity of the beam. Fading was observed to be exponential with an average decay constant of .0043 units/hr. The highest response and best reproducibility were observed when kapis discs were placed normal to the beam. It was observed that irradiation increased the sensitivity of kapis, thus indicating the possibility that new traps were created—a property observed also in LiF. No definite relationship between the thermoluminescence and the weights nor the thickness of kapis shells could be seen. It is possible that other factors (namely the age of the shell, geographical origin, climatic conditions, as well as weight and thickness) are parameters that affect the thermoluminescence of kapis. The effect of pre-irradiation and post-irradiation annealing on the sensitivity of kapis is also shown. (auth)

17390 (RISO-249(Pt.3), pp 1193-1194) EXPERIMENTAL MODIFICATION OF THERMOLUMINESCENCE BY STATIC AND EXPLOSIVE DEFORMATION. **McDougall, D. J. (Loyola Coll., Montreal). Dec 1971.**

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

In numerous rock units, deformational strain appears to have been an important factor in either increasing or decreasing the thermoluminescence response of crystals and crystal aggregates. Variations in impurity elements, natural radioactivity, and natural heating do not appear to have been of the proper order of magnitude to have brought about the observed changes. A series of experiments on the deformation and rupturing of crystals have been conducted and include: crushing and grinding of crystalline material; packing of glass beads in sample holders; formation of pellets from powders under high pressure; loading of slices of crystalline aggregates; and explosive deformation of bars of crystalline aggregates. It is concluded that moderate deformation may immediately increase certain glow-curve

peak heights by as much as several hundred percent without any additional radiation dose. Greater amounts of deformation may cause an increase in one peak and a decrease in another. Rupture of crystal lattices by fine grinding or explosive shock greatly reduces or destroys the thermoluminescence properties of crystals. (WHK)

17391 (RISO-249(Pt.3), pp 1195-1208) SOME DOSIMETRIC PROPERTIES OF SINTERED ACTIVATED CaF_2 DOSIMETERS. Uran, D.; Knezevic, M.; Susnik, D.; Kolar, D. (Josef Stefan Nuclear Inst., Ljubljana, Yugoslavia). Dec 1971.

From third international conference on luminescence dosimetry; Risoe, Denmark (11 Oct 1971).

The influence of the preparation and sintering conditions on the properties of sintered CaF_2: Mn dosimeters was studied. An improved reading instrument was developed. The aim of the work was to develop an accidental personal dosimeter with corresponding instrumentation. (auth)

17392 MEASUREMENT OF ABSORBED RADIATION DOSE BY DEGRADATION OF LUMINESCENCE IN ANTHRACENE. Doroshenko, V. N.; Chervetsova, I. N.; Kabakchi, A. M. This paper was summarized in At. Energ. (USSR); 31: No. 6, 622-623(Dec 1971) as paper No. 548/6369. (In Russian).

Full copy of this paper is held by TIC.

A study to test the possibility of using the degradation of luminescence in anthracene to determine the absorbed dose in an organic material in contact with metals or other solids is described. The luminescence spectra obtained by irradiating 1 to 5 mm thick anthracene crystals, films 0.06 to 0.16 mm thick, and thin (<100 nm) layers adsorbed on aluminum surfaces with ^{60}Co γ-rays were studied. The dependence of the degree of quenching of the luminescence radiation on the absorbed dose was studied by measuring $\Delta J/J_0 = (J_0 - J)/J_0$, %, where J_0 and J are, respectively, the integrated intensities of luminescence in the 400 to 500 nm region before and after irradiation. It was found that $\Delta J/J_0$ varied the same way with dose for all samples studied. The quenching of the luminescence of a 0.1 cm thick crystal film of anthracene irradiated between metallic plates of the same thickness determines the ratio of the dose absorbed in this heterogeneous system to the dose in a single crystal of anthracene. The data obtained (1.08 for aluminum, 1.3 for nickel, and 1.65 for gold) are in good agreement with values reported in the literature. The experimental results show that degradation of luminescence can be used in the 0.2 to 3 Mrad range to determine the absorbed dose in an organic layer in contact with a solid. (WAK)

17393 ASSOCIATED PARTICLE 14-MeV NEUTRON TIME OF FLIGHT SPECTROMETER FOR USE WITH SMALL ACCELERATORS. Baynham, D. E.; Cox, A. J. (Astron Univ., Birmingham, Eng.). Int. J. Appl. Radiat. Isotop.; 23: No. 12, 561-565(Dec 1972).

The 14-MeV neutron time of flight spectrometer used with a 150-keV SAMES Type J accelerator at the University of Aston is described. The use of the associated particle technique to provide a zero time signal is shown to produce count rates near to that produced by klystron bunching techniques and angular resolutions at least equal to those achieved on larger accelerators. The way in which the spectrometer is used to measure the differential cross-sections for elastic and inelastic scattering of 14-MeV neutrons for ^{14}N is described. (auth)

17394 DOSIMETER FOR PENETRATING IONIZING RADIATION OF ANY COMPOSITION AND SPECTRUM. Zielczynski, M.; Zarnowiecki, K. U. S. Patent 3,710,116. 9 Jan 1973. Priority date 5 Mar 1968, Poland.

A dosimeter includes a detector provided with a cylindrical inner measuring electrode and a pair of outer semi-cylindrical voltage electrodes, the latter being supplied with voltages of opposite polarity to provide in the space between electrodes a differential chamber having a first saturated volume and a second volume for column recombination of ions, the two volumes overlapping. A recorder is connected with the measuring electrode to provide a measure of dose equivalent. (Official Gazette)

17395 THERMOFLUORESCENCE METHOD OF DETERMINING RADIATION LOADINGS IN ROENTGEN DIAGNOSIS. Zubkova, T. I.; Yudin, M. F.; Kuznetsov, A. I.; (and others) (All-Union Scientific-Research Inst. of Metrology, Leningrad). Med. Radiol.; 17: No. 7, 51-6(Jul 1972). (In Russian).

Measurement of absorbed doses in roentgenodiagnostic procedures both in the body and in separate organs is studied. It is established that the thermoluminescence method of dosimetry is most expedient for this purpose. This method was used to measure integral absorbed doses in a number of organs and the whole body, in stomach roentgenoscopy and hysterosalpingography. The results obtained may be used by physicians-roentgenologists in assessment of radiation loadings in roentgenodiagnostic procedures. (auth)

17396 UTILIZATION OF EMISSION FILTRATION IN TESTING DOSIMETERS ON THE STANDARD UPGD UNIT. Balon, Z. P.; Lyalina, L. I.; Lavrenina, R. V. Med. Radiol.; 17: No. 7, 64-7(Jul 1972). (In Russian).

Results of experimental identification of the attenuation multiplicity factor for testing γ-radiation dosimeters (UPGD) employing lead filters are presented. The values obtained for the attenuation multiplication factor differ from the data reported in the literature for a wide beam but are similar to those for a narrow beam (B = 1). This indicates that the effect of the scattered radiation from the filters on the working filtered beam of gamma rays is negligible. Thus filtration with the UPGD unit can be utilized for extending the dose power range when testing dosimeters with one emitter. (auth)

17397 CHARACTERISTICS OF A SIMPLIFIED INSTALLATION FOR HUMAN GAMMA RAY DOSIMETRY. COMPARISON OF ITS PERFORMANCE WITH THAT OF CONVENTIONAL EQUIPMENT. Frossard, H.; Perles, R.; Poutrain, P. (Centre de Recherches du Service de Sante des Armees, Clamart, France). pp 337-51 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The health physics department of the Army Health Service Center has developed a simplified whole body gamma ray dosimetry system for monitoring personnel exposed to ionizing radiations during their work. This mobile installation, which is mounted on a van, represents a substantial saving in weight and the amount of equipment used. The performance of this equipment is compared with that of conventional equipment using a shielded room and three measuring probes. (France)

17398 TESTING DOSIMETERS WITH PULSED RADIATION: APPLICATIONS TO THE STUDY OF THE RESPONSE OF AN IONIZATION CHAMBER DETECTOR. Bermann, F.; Hulot, M. (CEN de Saclay, Gif-sur-Yvette, France). pp 407-22 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

A series of dosimeters representing those most widely used in health physics were selected for experiments with pulsed x-ray machines and linear accelerators. The results of these experiments were analyzed and supplemented by the results of experimental investigations of the transient behavior of ionization chamber detectors subjected to pulsed irradiation. It seems probable that the electronics associated with the dosimeter may account for its response being dependent upon the form of the ionizing radiation pulse. (France)

17399 CALIBRATION PROCEDURES USED BY THE HEALTH PHYSICS SECTION OF SACLAY: APPLICATIONS TO PHOTON DETECTORS. Troesch, G.; Simoen, J. P.; Sklavenitis, L. (CEN de Saclay, Gif-sur-Yvette, France). pp 431-43 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The Health Physics Section of Saclay establishes the technical specifications of radioprotection detectors. The establishment of the calibration characteristics necessitates the use of the appropriate sources and poses problems concerning the reference value. The calibration characteristics of two detection apparatus for photons between 0.01 and 10 MeV are given: the Nardeux-Babyline 20 portable ionization chamber and the BEFIC-IF-103-SN-type teleratemeter. (France)

17400 CRITICALITY ACCIDENT DOSIMETRY AT THE CEA. Tabardel-Briand; Anno; Bricka; (and others) (CEA, Paris). pp 445-57 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

An original, inexpensive, and easy-to-use criticality accident dosimetry system has been developed by the CEA. It is indicated how problems relating both to area dosimetry and personnel dosimetry can be resolved. In less than 24 hours after an accident, the system will provide an evaluation to within 50% of the maximum absorbed dose and will subsequently define in terms of fluence and radiation field spectrum (within 25%), the degree to which individuals have been exposed. Cooperation between the Local Health Physics Divisions, Radiological Safety Research Division, and the Health Physics Technical Service Division has enabled the widespread installation of this system in CEA centers and establishments working for the CEA. Recommendations have been drawn up concerning the specifications and operation of the system. Inter-

calibrations and a simulated accident with the CRAC source were used to familiarize users with the methods used to handle the data. The French criticality dosimeter system has been compared with systems used by other countries at meetings arranged by the AIEA at Valduc (France 1970) and Oak Ridge (United States 1971). (France)

17401 IMPROVEMENT IN THE PERFORMANCE OF CELLULOSE NITRATE FILMS FOR THE DOSIMETRY OF IONIZING PARTICLES. Barbier, J.; Renard, G. (Societe Kodak-Pathe, Paris). pp 475-86 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The Kodak LR 115 experimental film consists of a 10 μ thick film of α sensitive cellulose nitrate on an inert polyester substrate. It was discovered that the latent images of tracks recorded on this film are subject to considerable fading at high temperatures (70 deg C); this fading can exceed 60% in one hour. As the recommended development procedure involves treating the irradiated film with 2.5 N sodium hydroxide at 60 deg C for 90 minutes, it was suggested that the development process competes with the tendency of the track image to fade. It was suggested that low temperature development would reveal more information. This assumption was proved valid. An improvement was made in the discrimination between the irradiated areas and the background by modifying the development process: 75 hours at 25 deg C instead of 90 minutes at 60 deg C. A simultaneous reduction in the background level was obtained because of the improved discrimination between irradiated and non irradiated areas. This new method of utilizing the LR 115 film is of considerable interest in the dosimetry of weak α sources (10^{-15}Ci). (France)

17402 FIVE YEARS RESEARCH ON RADIOLUMINESCENCE DOSIMETRY AT THE FONTENAY-AUX-ROSES RESEARCH CENTER. Portal, G. (CEN de Saclay, Gif-sur-Yvette, France). pp 487-501 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The results of five years research in the CEN FAR laboratories on the development of dosimetric techniques utilizing radiothermoluminescence are reviewed. Studies relating to the development of various types of radiothermoluminescent materials designed to resolve a number of specific problems are presented. Particular emphasis is given to progress already made in improving the characteristics of lithium fluoride used in personnel dosimetry. The results of technological studies leading to the development of detectors based on radioluminescent materials are presented. The development of an improved reading system is discussed. (France)

17403 TRENDS AND POSSIBILITIES FOR AUTOMATISATION IN PERSONNEL DOSIMETRY. Hoegl, A. (Frieseke und Hoepfner GmbH, Erlangen, Ger.); Maushart, R. M. pp 523-42 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Large-scale routine personnel dosimetry can only be performed effectively and reliably when both the dosimeter reading manipulations and the data evaluation process are performed automatically. Most film badge services are automated nowadays. However the lack of automation in the treatment of information from TLD and RPL dosimeters is a great disadvantage. Even for certain well known and extensively used ionization chamber type dosimeters, commercial automatic reading devices are not available. The development of automatic reading and data processing equipment is discussed. Examples of prototype instruments for RPL dosimeters and pocket ionization chambers are given. (France)

17404 AUTOMATIC PROCESSING AND HANDLING OF DOSIMETER FILM DATA BY THE EDF. Buschlen, D. (Electricite de France, Paris). pp 543-57 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The Health Physics Division of the EDF (Electricite de France) has developed an automatic processing system for film badges worn by nuclear plant personnel. This system involves three separate processes: a marking machine which identifies each dosimeter by irradiating its x-ray sensitive surface through a coding matrix specific to each individual (the identification number being stamped on the film envelope); a reader, which after the utilization and development of the dosimeter film, decodes the identification, measures the degree of blackening, and detects any unusual surface marks e.g., spots and nonuniformity of the dosimetric zones (If an anomaly is detected the dosimeter concerned is rejected from the processing series and individually examined using conventional techniques); and an IBM punch electrically coupled to the reading and decoding machine which compiles a punched card for each film processed. A data handling computer computes the monthly and cumulative doses received by individuals in relation to current regulations and compiles individual exposure statements and cards. This system handles 3000 dosimeters per month, the results being available about 20 days after the receipt of the film badges. (France)

17405 PERSONNEL NEUTRON DOSIMETER. Hoy, J. E. (to United States Atomic Energy Commission). U. S. Patent 3,699,337. 17 Oct 1972. Filed 16 Mar 1971.

A dosimeter is disclosed for measuring the neutron dose equivalent for spectra of widely different energy distributions. A hemispherical mass of neutron moderating material is divided into two segments by a layer of thermal neutron absorbing material. Each segment has a thermal neutron detector at its base surface. Another layer of thermal neutron absorbing material covers the curved surface of the hemispherical mass but has a portion of reduced thickness at the apex. Neutrons passing through and backscattered from the wearer are monitored by one of the neutron detectors while the second detector corrects for directly impinging thermal neutrons that contribute a disproportionately small amount to the dose. (Official Gazette)

17406 MICROCALORIMETRIC MEASUREMENT OF γ-RADIATION. Robert, J.; Dalmazone, J. (Laboratoire Curie, Paris). Int. J. Appl. Radiat. Isotop.; 23: No. 12, 575-579(Dec 1972). (In French).

At the Centre d'Etudes Nucleaires de Saclay, a system has been installed to measure strong radioactive sources. According to the types of calorimeters used, this apparatus discriminates quantities of heat given out from the absorption of β or γ radiations. It permits the study of the quantities of radiations absorbed through various elements during irradiation by ^{60}Co and ^{137}Cs. With thicker calorimeters, it was shown that freed energy through absorption increases faster than according to exponential law, owing to the degeneration of γ radiation. This is the only system which can determine the absolute intensity of radioactive sources having higher strength than one curie. (auth)

17407 SOLID DICARBOXYLIC ACIDS AS IN-PILE CHEMICAL DOSIMETERS. Gal, O.; Premovic, P. (Institut za Nuklearne Nauke Boris Kidric, Belgrade). Int. J. Appl. Radiat. Isotop.: 23: No. 12, 541-544(Dec 1972).

Radiolytic decomposition of succinic acid induced by mixed pile radiation was studied with respect to dosimetric use at high reactor power levels, from 2 to 10 MW, and dose rates from 20 to 120 Mrad hr^{-1}. A linear relationship between the absorbed dose and the logarithm of weight losses caused by radiation, as in the case of solid oxalic acid, was found. The radiolytic behavior of succinic acid and oxalic acid dihydrate is compared, especially the effect of temperature on the radiolysis. (auth)

17408 DOSIMETRY OF A ^{85}Kr IRRADIATION FACILITY FOR CHEMICAL REACTION. Ootsuka, N.; Yamamoto, T. (Japan Atomic Energy Research Inst., Takasaki, Japan). Oyo Butsuri; 41: No. 9, 996-1005(Sep 1972). (In Japanese).

^{85}Kr irradiation equipment has been devised for inducing chemical reactions in the liquid phase. Irradiation is achieved by circulating the ^{85}Kr gas in a reaction system, where the ^{85}Kr gas forms bubbles in the liquid reactant. The dosimetry is carried out for the reaction system using aqueous solutions of methylene blue. The observed relationship between the absorbed dose rate in the reactant and the fractional void in the reaction vessel agrees well with the theoretically obtained relationship. (auth)

17409 EXTENSION OF THE RANGE OF MEASUREMENT OF AN INTEGRATING FARMER DOSIMETER. Dardenne, J. C.; Wambersie, A. (Univ., Louvain, Belgium). J. Belge Radiol.; 55: No. 3, 361-364(1972). (In French).

A method to extend the range of measurement of a Farmer Secondary Standard Dosimeter is described. The range of 0 to 60 R for the old models can be extended to about 0 to 600 R by simple addition of a condenser. The technical precautions to be taken to perform this modification are described. (auth)

17410 DOSIMETRY OF LOW ENERGY X RAYS USING LiF. Law, J. (Univ. of Edinburgh). Phys. Med. Biol.; 18: No. 1, 38-45(Jan 1973).

LiF type 7, in loose powder form, was irradiated with x rays generated at potentials between 50 and 25 kV, having effective energies between 26 and 11 keV and also with ^{60}Co γ-rays. The response of the LiF, per rad in LiF, was not significantly different for the x rays and the ^{60}Co radiation. X-ray doses in the LiF were

calculated from measurements made with a free air chamber. (auth)

17411 CORRECTION FILTERS FOR THE TYPICAL DOSIMETRY HALOGEN G-M COUNTERS. Dzisiow, A.; Krupa, R. J.; Probulski, S. (Jaroslawa Dabrowskiego, Warsaw). Nukleonika; 17: No. 9, 477-493(1972). (In Polish).

A brief analysis of the energy response as an integral parameter of dosimetric Geiger counters is presented. The concept of a two-ply filter is described and justified by this analysis. Such a filter would correct the energy response of a counter inserted into it. The method of calculating the optimum parameters of the filter construction is described. The method indicates the energy range in which a filter is effective, and indicates its effectiveness. For example, the method described was used for filters for DOI-30 and DOI-80 counters; comparison of the energy responses of the counters with filters and without (Sn + plexiglass) indicated the great utility and effectiveness of the filters. (auth)

17412 THERMOLUMINESCENT RESPONSE OF LITHIUM FLUORIDE TO HIGH ENERGY PHOTONS. Turner, A. P.; Anderson, D. W. (Univ. of Oklahoma, Norman). Phys. Med. Biol.; 18: No. 1, 46-52(Jan 1973).

The thermoluminescent response per rad in water for $1 \times 1 \times 6$ mm ^{7}Li-enriched LiF rods was measured for ^{60}Co γ rays and X-ray beams of 35, 50 and 65 MV. A 10% decrease in sensitivity to the high energy X-ray beams was found when compared to the sensitivity to ^{60}Co γ rays. No difference was observed between the sensitivities at 35, 50 and 65 MV. All measurements were made at approximately 400 rads which is within the linear part of the dose-response curve. The absolute dose in water was measured with a ferrous sulphate dosimetry system. Cavity theory calculations could be used to explain the decrease in sensitivity to the high energy X-ray beams as being due to a decrease in dose in LiF rather than due to a decrease in thermoluminescence. Calculated and measured sensitivities agreed within the level of systematic errors. (auth)

17413 STATISTISCHE AUSWERTUNG VON KERNSTRAHLUNGSMESSUNGEN. (Statistical evaluation of nuclear radiation Measurements). Weise, L. Munich; Oldenbourg (1971). 160p.

The book is intended for persons working in the field of nuclear radiation measurement techniques because it summarizes and comprehensively discusses the statistical evaluation of results, e.g., probability distributions; errors due to incorrect statistics; corrections for recorded event numbers as a consequence of counting losses; problems of time and energy resolution; statistical evaluation of parameters; statistical test procedures and their applications; adaption tests; and counting statistics and measuring time examples for the optimization of experiments. (GF)

17414 COMPARISON OF FILM BADGES AND THERMOLUMINESCENT DOSIMETERS USED FOR ENVIRONMENTAL MONITORING. Fitzsimmons, C. K.; Horn, W.; Klein, W. L. (National Environmental Research Center, Las Vegas, NV). Radiat. Data Rep.; 13: No. 10, 537-545(Oct 1972).

Data obtained from two concurrent dosimetry networks operated by the National Environmental Research Center, Las Vegas, Nev., are compared. One network utilizes the film badges and the other, thermoluminescent dosimeters (TLD). Gamma exposures from a few mR to approximately 1 R due to both natural background and fission products in the environment are more easily and accurately measured by the TLD system. Where the minimum detectable exposure for film is about 45 mR, the TLD sensitivity is on the order of 1 mR (which allows measurement of monthly background exposures). The insensitivity of TLD's to environmental heating, humidity, light damage, and pressure makes them ideal for use in the extreme conditions encountered in the desert. Heat damage to the film was seasonal with the greatest losses occurring in the summer. During July 1967, 71 percent of the film badges issued were heat or light damaged, while no loss of TLD data occurred. No background information was obtained from film data during 1967, but the geographical variations in background exposure rates were clearly disclosed by the TLD's. (auth)

17415 PRECISION DOSIMETRY OF HIGH ENERGY RADIATION. Chalkley, L. U. S. Patent 3,710,109. 9 Jan 1973. Filed 27 May 1970.

In the use of dye cyanide solutions for the dosimetry of radiations with energies above 6.5 electron volts, precision is attained by de-aeration of the dye cyanide solution and irradiation under conditions that exclude gaseous oxygen. (Official Gazette)

17416 RADIATION DOSIMETER HAVING TWO IONIZATION CHAMBERS WITH DIFFERENT RATIOS OF NEUTRON TO GAMMA RADIATION RESPONSES. Cooper, P. N.; Tymons, B. J. (to R. A. Stephens and Co. Ltd.). U. S. Patent 3,707,632. 26 Dec 1972. Priority date, 2 Dec 1969, Great Britain.

An ionization dosimeter with two ionization chambers having different ratios of neutron radiation response to gamma radiation response is described. One pair of corresponding electrodes of the two chambers are connected directly together. The other pair of corresponding electrodes are coupled through a capacitance. The two chambers are electrically charged in opposite polarities so that the change in potential across the capacitance is proportional to the difference between the responses of the two chambers. The value of the coupling capacitance can be chosen so that the potential represents either the effective biological radiation dose, or the neutron radiation dose. (Official Gazette)

17417 COMPARISON OF THE RESULTS OF ABSOLUTE MEASUREMENTS OF ABSORBED DOSE IN A BEAM OF GAMMA RADIATION WITH TWO CALORIMETERS OF DIFFERENT DESIGN. Bregadze, Yu. I.; Isaev, B. M.; Nagl, I.; Tultaev, A. V.; Khaider, I. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 6, 923-7(Jun 1972).

Translated from Izmer. Tekh.; 15: No. 6, 66-9(Jun 1972).

Results of an intercomparison of the calorimetric dosimeter at the All-Union Scientific Research Institute for Physicotechnical and Radiotechnical Measurements and the calorimetric dosimeter at the International Atomic Energy Agency for absolute gamma absorbed dose measurements are reported. The results obtained are within the limits of 1.5%. (WHK)

Nuclear Spectroscopic Instrumentation

17418 (BNWL-SA-3884) DEVELOPMENT AND APPLICATION OF A BETA-GAMMA-GAMMA MULTIDIMENSIONAL SPECTROMETER. Wogman, N.A.; Brodzinski, R.L. (Battelle Pacific Northwest Labs., Richland, Wash.). (nd). Contract AT(45-1). 12p. (CONF-721202-10). Dep. NTIS. From Nuclear Science Symposium; Miami Beach, Florida, United States of America (USA) (6 Dec 1972).

A beta-gamma-gamma multidimensional spectrometer has been developed which employs two 12-inch diameter by 8-inch thick NaI(Tl) crystals with associated 4-inch thick NaI light pipes and two 5-inch diameter by 1/2-inch thick gas proportional counters as principal detectors and which utilizes two 40-inch diameter by 24-inch thick plastic phosphors as anticoincidence shields. The detector system is coupled to two 4096 word computer memories which record gamma-ray events in coincidence with either beta detector. The gamma-ray energies identify the radionuclide while the beta detectors can identify the relative position of the radioactivity in the specimen being analyzed. The background and efficiency of the system and its application to the identification of radionuclides in environmental, biological, and extraterrestrial materials are discussed. (auth)

17419 PRIZMENNYE BETA-SPEKTROMETRY I IKH PRIMENENIE. Sbornik dokladov seminara sostoyaushchegosya v vil' nyuse, 22-26 Aprelya 1971 g. (Prismatic beta-spectrometers and their application. Collected reports of the seminar held in Vilnyus, USSR, April 22-26, 1971). Kalinauskas, R. A. (ed.). Vilnyus, USSR; Institute of Physics of the Lithuanian Academy of Sciences (1971). 251p. (CONF-710462-).

From Prismatic Beta-Spectrometers and Their Application Seminar; Vilnius, Union of Soviet Socialist Republics (USSR) (22 Apr 1971).

A collection of 17 papers is presented that includes two surveys: magnetic prism beta-spectrometers (52 references), and prism spectrometer techniques (24 references). The comparative characteristics of precision beta-spectrometers, problems in measurement, and the use of permalloy magnets and magnetic prisms are discussed in subsequent papers. The determination of internal electron conversion spectra was elucidated for ^{117m}Sn, ^{119m}Sn, ^{121m}Te, ^{123m}Te, ^{125m}Te, ^{127m}Te, ^{129m}Te, and ^{183}Ta. Multipole orders of γ-transitions, and experiments on delayed E1-transitions were considered. (KSW)

17420 METHODS AND RESULTS CONCERNING γ-RAY SPECTROMETRIC ANALYSIS IN RADIOPROTECTION AT THE CEN, SACLAY. Zerbib, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 141-63 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Problems associated with the applications of spectrometric measurements in health physics are outlined. The measurements are complicated by the following requirements: the many different ways of sampling the radioactive products (phase geometry); the large number of different nuclides formed. Ge(Li) detectors are gradually replacing NaI(Tl) detector crystals. The advantages and disadvantages of these two types of measurements are outlined. Statistical information concerning the spectrometric analysis carried out at Saclay is presented. (France)

17421 AUTOMATIC ANALYSIS OF γ RAY SPECTRA OBTAINED WITH A Ge(Li) JUNCTION USED FOR QUANTITATIVE ANALYSIS OF RADIOACTIVE SOURCES. Jaureguy, J. C. (Laboratoire Central de l'Armement, Arcueil, France). pp 599-617 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The use of this system reduces the amount of data required to analyze the spectrum by a high-capacity computer. When the storage is completed, the small computer gives the mean energy and the surface area of the total absorption peaks as well as indications of the half height width. The values calculated are then introduced into a high-capacity computer provided with a store containing a table of main radioisotopes (production modes, parents, cross sections, half lives, principal lines and branching factors, decay chains etc.) and detector efficiency curves for various geometries. A program is then used to edit lists of radioisotopes which might exist in the sources being investigated, and to give calculated activities for each characteristic line. This table can be used to identify radioisotopes from their principal lines; this calculation is easier than calculations based on the activities corresponding to the areas defined by these lines and gives similar results. Where short half-life emitters are concerned the computer can be used for determining in real time, the sampling required to measure the radioactive half-life associated with each line. This technique employs a program for the automatic exploration of total absorption peaks, which is highly compact (150 octaves) and fast to use (less than 5 seconds to test data stored in a 4K store). (France)

High Energy Physics Instrumentation

Refer also to abstracts 17994, 17995, and 18009.

17422 (UH-511-107-71) HIGH-PRECISION QUANTAMETER FOR NAL. Yount, D. (Hawaii Univ., Honolulu). Sep 1971. Contract AT(04-3)-511. 21p. Dep. NTIS.

Specifications and design parameters are given for a high-precision ionization quantameter to be used at NAL. The gain per GeV is expected to be independent of beam energy to ±0.3% from 1 GeV to 1000 GeV and to be independent of beam intensity up to the maximum photon flux that can be produced by 10^{13} interacting protons per 1-sec pulse in this energy range. The response is expected to be independent of the incident beam position to ±0.3% or better over a radius of 5 cm and to ±2% or better over a radius of 15 cm measured from the quantameter axis. (auth)

17423 TOTAL-ABSORPTION CHERENKOV COUNTER FOR THE SEPARATION OF ELECTRONS AND π MESONS OVER A WIDE ENERGY RANGE. Gol'dshtein, V. A.; Ogurtsov, V. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 651-653 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 34-36(1972).

A Cherenkov total-absorption counter using a KRS-6 single crystal (TlCl–TlBr) is described which allows electrons having an energy above 200 MeV to be recorded against the background of π mesons. The total ranges of the particles of a shower formed by an electron in the counter radiator are comparable with the theoretical values. The resolving power of the counter is determined in the electron-energy range from 250 to 1150 MeV. (auth)

17424 OPTICAL ELASTIC GLUES BASED ON LOW-MOLECULAR POLYORGANOSILOXANE RUBBER. Severnyi, V. V.; Minsker, E. I.; Chukin, V. S.; Kvasnovskaya, N. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 822-825(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 176-179(1972).

Results are presented of investigations of the optical, physicomechanical, and thermomechanical properties of elastic self-vulcanized glues of cold solidified "Elastosil" which were recommended for use in optical systems of instruments (in particular, in Cherenkov and scintillation counters) at working temperatures ranging from –40 to 200°C and from – 80 to 200°C. (auth)

17425 EQUIPMENT TO STUDY NUCLEAR INTERACTIONS OF NUCLEONS IN ENERGY REGION 5×10^{11} to 2×10^{13} eV WHICH CONSISTS OF AN IONIZATION CALORIMETER AND HODOSCOPIC SYSTEM. Mamidzhanyan, E. A.; Azaryan, M. O.; Badalyan, R. A.; Martirosov, R. M.; Muradyan, M. M. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 3, 221-228(1972). (In Russian).

Equipment for the investigation of strong interactions of nucleons in the energy region of 5×10^{11} to 2×10^{13} eV is described. The equipment consists of an ionization calorimeter and hodoscope system for identification of the hadron charge. The detailed analysis of parameters of the hodoscope system is given. On the basis of preliminary operation of the apparatus (for more than 1000 hours) this equipment is found to provide an effective way of studying the nuclear interactions of nucleons. The operation was carried out at 3250m above sea level. (auth)

17426 MULTIWIRE AND MULTIPURPOSE: DEVELOPMENT OF MULTIWIRE PROPORTIONAL CHAMBERS. Charpak, G. CERN Cour.; 12: No. 11, 362-364(Nov 1972).

The development of multiwire proportional counters and their use in high-energy physics experiments and radiodiagnosis are briefly reviewed. (WHK)

17427 DETECTING DIFFERENTLY. A. ULTRASONIC BUBBLE CHAMBERS. Hilke, H. CERN Cour.; 12: No. 11, 367-368(Nov 1972).

The development of ultrasonic bubble chambers at CERN is briefly reviewed. The primary problem discussed is the difficulty in acoustically matching the ceramic material of the piezoelectric transducer and the hydrogen. (WHK)

17428 DETECTING DIFFERENTLY. B. HYDROGEN STREAMER CHAMBERS. Rohrbach, F. CERN Cour.; 12: No. 11, 369-370(Nov 1972).

The operation and development of hydrogen streamer chambers at CERN are reviewed. The development of a high-voltage pulse generator using a Blumlein coaxial line to shape the pulse is described. (WHK)

Radiometric Instruments

Refer also to abstract 17687.

17429 (EURISOTOP-32) TECHNICAL-ECONOMIC STUDY OF THE RADIOMETRIC MEASUREMENT OF LEVELS AND DENSITIES DURING THE PRODUCTION OF ALUMINUM OXIDE. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Mar 1971. 30p. (In French). Dep. NTIS (U. S. Sales Only).

Two cases of radiometric measurements applied to the production of aluminum from bauxite are reported. In the first the filling level is measured continuously on autoclaves with a steel wall thickness of 30 mm. This measurement permits a continuous addition of bauxite. The second use measures the density of the leach at the moment where its dilution goes from 1.5 to 1.25 g/m^3 or where the pressure goes from 12 atm to normal pressure. The filling detector uses ^{60}Co and a scintillation counter. The density meter uses ^{137}Cs and a scintillation detector. The economic and technological advantages of radiometric measurement are discussed. (J.S.R.)

17430 (EURISOTOP-64) CONTINUOUS THICKNESS GAUGING OF ZINC COATINGS WITH RADIOISOTOPES IN CONTINUOUS-STRIP GALVANIZING PLANTS. Carl, W. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). May 1972. 18p. (In German). Dep. NTIS (U.S. Sales Only).

Continuous thickness gaging of zinc coatings in steel sheet is performed with beta backscattering and x-ray fluorescence excitation. The radiometric equipment used is not complex and is suited to the requirements of modern continuous-strip galvanizing plants. The introduction of a radiometric device into a galvanizing plant enables net annual savings of DM 266,000 to be made, largely by reduced zinc consumption. Reductions of scrap, quality improvements and a stepping-up of productivity are further benefits from the application of radiometric methods; these are, however, not included in the figures quoted. (EURATOM)

17431 (EURISOTOP-66) TECHNICAL-ECONOMIC STUDY OF THE CONTINUOUS MEASUREMENT OF THE HUMIDITY IN WOOD SANDWICHES BY MEANS OF NEUTRONS. Koch, E. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). May 1972. 22p. (In French). Dep. NTIS (U. S. Sales Only).

The measurement of the moisture content of wood shavings by the use of neutrons in the preparation of cellulose and during the processing of wood is reported. The general problems in the measurement of the moisture with neutrons are outlined. The neutron measurement installation is described in detail, and the procedure for the determination of the dry weight of the shavings is outlined. The economic advantages are discussed. (JSR)

17432 (EURISOTOP-69) RADIOMETRIC LEVEL MEASUREMENT AND CONTROL. Heier, K.; Trost, A. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). May 1972. 101p. (In German). Dep. NTIS (U.S. Sales Only).

Level measurements in containers, bunkers, or reactors have assumed great importance in several branches of industry. Since there is no simple method of measuring levels which is ideally suited to every conceivable instance, many such methods have been developed which are based on a wide variety of technologies. The

main advantage of radiometric techniques over others is that they permit contact-free operation, so that the measurements are effected through the container wall without any electrical or mechanical connection with its interior. Depending on the problem involved in these level measurements, gamma, beta, and also neutron emitters are used as radioactive emitters in point or linear formation. They operate by the absorption or back-scattering principle. In order to prevent contamination of their surroundings, all of the emitters are tightly sealed in one or several inactive containers and in addition are installed within a suitable shield, which only allows the required radiation beam to pass through in the direction of the detector. Depending on the requirements set for the portable or fixed measuring devices, either halogen or scintillation counters are used. The equipment is installed in the form of limit level monitoring devices or as quantitative measuring devices using vertical or horizontal irradiation, or as automatic control units, depending on the type of measurement required. The following concrete examples are described: flue-height monitoring devices for cupola furnaces, level controllers for ignition coils, high-tide warning devices, depth-measurements in blast furnaces, level measurements in degasifiers, bath level measurements in continuous casting plants, and glass-level measurements in melting furnaces. The radiation-protection regulations fixed by law can be met via various radiation-protection measures. One of these measures is the use of shielding, the effect of which can be calculated via simple formulas. (EURATOM)

17433 (IAEA-R-465-F) INVESTIGATIONS OF THE FLOW PARAMETERS IN INHOMOGENEOUS LIQUIDS IN PIPELINES BY MEANS OF RADIOISOTOPES. Part of a coordinated program of research in flow studies. Final report for the period 1 December 1966 – 30 September 1970. Przewlocki, K.; Michalik, A.; Nizegorodcew, P.; Korbel, K. (International Atomic Energy Agency, Vienna (Austria)). Jan 1971. 113p. INIS.

Radioisotope techniques were used to investigate the phenomena of hydrotransport. Parameters related to spatial distribution of concentration of solids and slip velocities during transport were investigated. Spatial distribution of solid dispersions was studied by scanning with a rotary gamma-ray beam device in which the source and detector moved around the pipe and also simultaneously along its radius. From the investigations on slip velocities it was known that the bulk solid remains stationary in the initial phase of flow, begins to drag along the bottom of pipe after reaching a starting velocity, and then finally moves as a continuous suspension. Such measurements would help exploit stowing installations for transporting sand and partially granulated stones. It was found that the control of the density of stowing mixture by means of radioisotope density gages having a maximum relative measurement error not exceeding 3%, permits the use of minimum amount of water into the excavation during stowing process. A discussion on the optimization of hydrotransport of suspended solids based on rational velocity concept was also given in order to determine the optimum density and volumetric ratio of the mixture. (INIS)

17434 SPECTRAL METHOD OF MEASURING COATING THICKNESS. Gruzin, P. L.; Rodin, A. M.; Skachkov, E. V. This paper summarized in At. Energ. (USSR); 31: No. 6, 623-624(Dec 1971) as paper No. 549/6371. (In Russian).

Full copy of this paper is held by TIC.

Problems associated with the utilization of monoenergetic electrons in backscatter thickness gaging, in place of the more commonly used radioisotope β-ray sources, were investigated. (TFD)

17435 THICKNESS GAGING BY GAMMA RAY ATTENUATION. Clayton, J. D. (Savannah River Plant, Aiken, SC). Mater. Eval.; 31: No. 2, 27-32(Feb 1973).

Uranium fuel elements are clad with aluminum at the Savannah River Plant for use in nuclear reactors. The processed fuel elements must pass many quality control tests prior to irradiation. Cladding end-cap thickness was formerly measured by radiography, a slow and expensive method. Gages that make use of a gamma ray attenuation technique have now been developed to determine quickly and automatically whether the aluminum end caps are thick enough. Relative changes in gamma radiation from a moving isotope source-detector arrangement are measured after transmittal through the uranium core and aluminum ends of tubular fuel elements. (auth)

17436 POSITIONING DEVICE FOR THE RADIATION ABSORBER OF THICKNESS MEASURING DEVICES. Wunsch, B. (to Exatest Messtechnik GmbH). U. S. Patent 3,706,888. 19 Dec 1972. Priority date 1 Oct 1969, Germany.

A radiation-type thickness measuring device has a radiation source for irradiating the object whose thickness is to be measured and a radiation detector for detecting the radiation transmitted by the object. A radiation absorber sheet is introduced into the radiation path to standardize the amount of radiation reaching the detector. Sheets of various thicknesses are carried circumferentially by a disk and the disk must be positioned accurately so that the correct sheet lies precisely where it should in the radiation beam. A positioning device is provided for the disk, having a bridge circuit of which two branches are formed by a potentiometer whose sliding tap is connected to the disk so that its position is dependent on the real position of the disk. The other two branches of the bridge are formed by a resistance chain whose intermediate tap can be selected in accordance with the desired position of the disk. A threshold switch in the form of a Schmitt trigger is controlled by the diagonal voltage of the bridge and controls a relay. When the diagonal voltage exceeds the threshold of the Schmitt trigger the relay connects the drive motor of the disk to a relatively high voltage source to operate the motor at a relatively high speed in the direction which reduces this diagonal voltage. When the bridge diagonal voltage falls within the threshold, the relay disconnects the motor from the high voltage source. A fine switch then takes over which connects the motor to a relatively low voltage for driving it at a low speed. When the disk reaches its exact desired position, a cam which is connected to the disk causes the fine switch to disconnect the motor from the low voltage source so as to stop the motor. (Official Gazette)

17437 DUAL DETECTOR COMPENSATED DENSITY WELL LOGGING SYSTEM. Janssen, H. W.; Mooring, J. F. (to Dresser Industries, Inc.). U. S. Patent 3,701,902. 31 Oct 1972. Filed 9 Jun 1971.

A density well logging compensation system is described wherein the outputs of the two detectors, which are spaced different distances from a gamma ray source, are applied to temperature compensated logarithmic amplifiers the outputs of which are compared to derive a correction signal which is employed to correct the output of one of the detectors to give true formation density. In connection with the spine and ribs plot of such a system, provision is made for adjusting both the spine angle and the rib angle so that the compensation system may be employed with density logging tools of different geometries and physical dimensions. Furthermore, provision is made for compensating for curvature of the rib with increasing mudcake thickness. Facilities are also provided for holding the source end of the logging instrument against the borehole wall to minimize errors in the compensated output of the system. (Official Gazette)

17438 EPITHERMAL NEUTRON PROBE FOR MEASURING THE WATER CONTENT OF SOILS. Cotecchia, V.; Pirastru, E. (CNEN, Bari, Italy). Geol. Appl. Idrogeologia; 5: 135-157(1970). (RT/GEO(72)4).

Many field studies of thermal neutron probes for measuring the water content of soils show that this apparatus is sometimes very much influenced by chemical composition of soil. The epithermal neutron probe avoids these errors. A theoretical study of the problem is also presented. (auth)

17439 DETERMINATION OF METAL COATING THICKNESS WITH A BETA-METER. Slobodanka, D. P. Zastosowan. Mat.; 18: No. 6-7, 219-224(1970). (In Serbo-Croatian).

A method is described for measuring metal coating thickness using radioisotopes and a β-radiation meter, with irradiation from a stable source. The apparatus and beta-meter parameters are described in detail, also the sequence of operations, and a calibration curve is given. Factors are analyzed which affect the accuracy of measurements, and a thickness range over which the method may be used for Au, Cu, and some alloys is given. (Corrosion Abstr.)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 18969 and 18974.

17440 (LYCEN-7237) TRIGGERING OF ANOMALOUS PHOTOCURRENTS IN BIPOLAR TRANSISTORS. Gaillard, R.; Genre, R. (Lyon Univ. (France)). Institut de Physique Nucleaire). Jun 1972. 20p. (In French). Dep. NTIS (U. S. Sales Only).

The threshold dose required to trigger anomalous photocurrents in two types of bipolar transistors having different structures (2N2369 and 2M3252) was determined in the short circuited emitter and base configuration. The CEA EUPHROSYNE radiation pulse generator was used. The peak value of these photocurrents occurs in the correct positions on the electrical characteristics of

the device in the large injection regimes; after switching, this value is independent of the dose. (France)

17441 (SC-RR-720871) METHOD TO DETERMINE REACTOR EQUIVALENCE OF NEUTRON THREAT SPECTRA. McKenzie, J. M. (Sandia Labs., Albuquerque, N. Mex.). 1 Dec 1972. 28p. Dep. NTIS.

An experimental method is given for the conversion of a neutron threat spectra to a reactor equivalence fluence. The method gives both the magnitude and error of the equivalence. It is applicable to circuits and systems as well as devices. (auth)

17442 PROPERTIES OF STIMULATED EMISSION OF A NEODYMIUM LASER UNDER THE INFLUENCE OF ^{60}Co GAMMA RADIATION. Arifov, U. A.; Bedilov, M. R.; Khaidarov, K. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 1, 21-23(1972). (In Russian).

Energy and spectral characteristics of Nd laser radiation, cross section distribution of the beam, and the absorption spectrum of the active element were investigated before and after exposing it to doses of γ radiation up to 10^7 R. The duration of the stimulated laser emission was accordingly reduced from 530 to 114 μs, and the excitation threshold was increased from 2 to 2.5 kJ. The emission energy decreased from 1.5 to 0.2 joules with increase of radiation dose (to 10^7 R). (2 figures) (KSW)

17443 SATURATION OF STIMULATED RADIATION OF A RUBY LASER THROUGH INTERACTION WITH GAMMA RADIATION OF ^{60}Co. Bedilov, M. R.; Khaidarov, K. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 6, 31-32 (1972). (In Russian).

The stimulated radiation of a ruby laser was investigated while under the action of a ^{60}Co gamma source of 100 R/sec. It was found that the energy of the laser depended on the radiation dose received and on the number of scintillations of the impulse lamp. The influence of the γ-rays on the characteristics of the stimulated radiation became noticeable beginning at 10^4 R, and at doses 10^6 to 10^8 R the stimulated radiation became saturated, i.e., the γ-rays no longer had an effect on the generation properties of the ruby laser. (KSW)

Miscellaneous Instruments

Refer also to abstracts 18756 and 18770.

17444 (CEA-N-1580) COMPARATIVE STUDY OF DC AMPLIFIERS: CARY 401, KEITHLEY 610, KEITHLEY 640, VICTOREEN 5100. Hilaire, M.; Redon, P.; Brethon, J.P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov 1972. 45p. (In French). Dep. NTIS (U.S. Sales Only).

The sensitivity, reliability, drift, and accuracy of dc amplifiers were tested in view of application in radiation metrology. (France)

17445 (EUR-4881) MODULAR DRIVE SYSTEM FOR NEUTRON CHOPPERS WITH DIGITAL SPEED AND PHASE-CONTROL. Eder, J.; Roebbelen, D. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Nov 1972. 26p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 40.-.

A modular drive system for synchronized multiple neutron choppers is described. Brushless reluctance synchronous motors supplied by solid state converters are used to give the system a high degree of reliability. A digital quartz reference generator provides the control signals for speed of the master chopper and serves as a pilot time base for all other systems. Phasing between different chopper rotors is achieved by digitally delaying the pilot signal. Since all drive modules are locked to the same frequency, drift problems due to fluctuations of electrical power and temperature are practically eliminated. An analog P-I control loop reduces short time phase fluctuations caused by mechanical effects. Start-up and synchronization procedures are semi-automatic. (Euratom)

17446 (KFK-1972) CAMAC PULSE GENERATOR LEM-52/13.2. Dietzel, G.; Fischer, P.-M. (Kernforschungszentrum, Karlsruhe (West Germany). Labor Fuer Elektronik Und Messtechnik). Oct 1972. 18p. (In German). Dep. NTIS (U. S. Sales Only).

A computer-controlled pulse generator in CAMAC, consisting of an ORTEC Type 419 pulse generator and a control unit, is described. The parameter "pulse amplitude fine" and a special parameter "partial range" to obtain an accuracy for adjustment of about 4×10^{-4} are computer-controlled. The variation of the parameters is done by relays and by a stepping motor driving a servo potentiometer with ten turns. The CAMAC pulse generator will be used in a fission experiment. (auth)

17447 (SC-RR-720719) HEAT TRANSFER IN INTRINSIC THERMOCOUPLES: APPLICATION TO TRANSIENT TEMPERATURE MEASUREMENT ERRORS. Keltner, N. R. (Sandia Labs., Albuquerque, N. Mex.). Jan 1973. 227p. Dep. NTIS.

Thesis. Submitted to Univ. of New Mexico, Albuquerque.

Intrinsic thermocouples are frequently used to measure rapidly varying surface temperatures on electrically conducting solids. Heat transfer between the substrate and the thermocouple introduces time lag errors into the measurements. To determine these errors, solutions for the interface temperature are obtained, for the case where the substrate undergoes a step temperature change, with both finite difference and analytical methods. The results indicate that the interface temperature response can be determined solely from the thermal properties of the materials. Comparison of the solution results with limited experimental results shows general agreement. An analysis of the differences between these results and possible errors in the experimental data points out some of the problems associated with the fabrication and experimental calibration of intrinsic thermocouples. The application of the results is discussed with regard to good experimental practices and numerical processing of data from specific thermocouple installations. Additional discussion includes application of the results to other types of thermal sensors and possible extensions of the study to include additional thermal effects and applications other than temperature measurement. (auth)

17448 MULTICHANNEL DEVICE FOR RECORDING THE PARAMETERS OF PULSED X-RAY RADIATORS. Dvornikov, I. V.; Pichugin, V. V.; Tolchenov, Yu. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 896-898(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 234-236(1972).

A device is described for simultaneous recording of the principal parameters of pulsed x-ray radiators using a multichannel high-speed automatic recorder. (auth)

17449 DEVICE FOR STUDYING LIGHT ABSORPTION IN DEFORMED SOLIDS FOR SIMULTANEOUS IRRADIATION WITH ELECTRONS. Troitskii, O. A.; Glazunov, P. Ya.; Shirshov, E. M.; Pikaev, A. K.; Skobtsov, I. L. (Inst. of Physical Chemistry, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 885-886(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 225-226(1972).

A device is described for measuring light absorption in deformed solids for simultaneous irradiation with electrons and with no irradiation; the device consists of a linear U-12 (4.5 MeV) electron accelerator, a kinetic spectrophotometer, and a machine for mechanical testing of the samples. Any transparent material may be subjected to testing with simultaneous recording of the optical absorption spectrum and the tension (compression) diagram. For a slight readjustment of the unit it may likewise be used to obtain the deformation reflection spectra. (auth)

17450 MASS SPECTROMETER FOR ANALYZING SOLIDS. Alpat'ev, Yu. S.; Dubinskii, I. N.; Ol'khovskii, V. L.; Pilipenko, A. P.; Cherepin, V. T. (Inst. of Metal Physics, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 798-800(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 159-160(1972).

An instrument is described for element and isotopic continuous layer-by-layer analysis of solids which is based on the phenomenon of secondary ion emission. A modernized radio-frequency single-pole mass spectrometer is used as the analyzer. The range of analyzed masses is from 1 to 250 for a mass-spectral resolution of 250 amu. (auth)

17451 AUTODYNE NMR-SIGNAL PICKUP WITH CONTROLLABLE LOW-FREQUENCY SELECTIVITY. Grinchenko, Yu. A. (All-Union Scientific-Research Inst. of Single Crystals, Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 781-782 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 145-146(1972).

The network of an autodyne pickup in an NMR spectrometer is presented which has low-frequency modulation of the field. By means of connecting a four-port having rejection properties at the modulation frequency into the feedback circuit which stabilizes the level of small oscillator oscillations, frequency selection of the useful signal without resort to narrowband amplification after the autodyne is achieved in the network. (auth)

17452 MASS SPECTROMETER WITH MAGNETIC WEDGE FIELD. Ioanoviciu, D.; Mercea, V.; Cuna, C.; Ardelean, P. (Institut for Stable Isotopes, Cluj). J. Phys., E (London); 6: No. 2, 129-130(Feb 1973).

A magnetic wedge field 180° deflecting mass spectrometer is described. A resolving power of 1340 is obtained with an ion source-collector distance of 18 cm. (auth)

17453 FLOW FLUOROMETER (Feb 1972) (Engineering Materials). (Oak Ridge National Lab., TN). (CAPE-2315). 3 drawings.

17454 MASS SPECTROMETER WITH TROCHOIDAL ION BEAM. I. THEORY. Ioanoviciu, D.; Mercea, V.; Cuna, C. (Inst. of Stable Isotopes, Cluj). Rev. Roum. Phys.; 17: No. 10, 1165-1175(1972).

The mechanical and space charge aberrations for the 180° deflecting wedge field mass spectrometer are calculated. The scattered ion current distribution at the collector is derived. The real performances of the instrument can thus be determined. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

17455 METHOD FOR PRODUCING TUBULAR RADIOACTIVE LIGHT SOURCES. Thuler, O. (to Canrad Precision Industries, Inc.). U. S. Patent 3,706,543. 19 Dec 1972. Priority date 22 Aug 1968, Switzerland.

The process for making tube-shaped, radioactive light sources is characterized by the fact that a glass tube containing a Luminophor and a radioactive gas, is subdivided successively into glass tube sections intended for use as radioactive light sources, by means of a laser beam. This is accomplished with a closely localized laser beam so that a sufficient quantity of glass is drawn from the sidewalls to form end walls, to divide the sealed tube and simultaneously seal the ends of the two tubes produced without loss of radioactive gas therein. (Official Gazette)

Isotope Separation (Industrial)

Refer also to abstract 17057.

17456 (AEC-tr-7344) PROBLEM OF PROTECTING SECRETS RELATED TO URANIUM ENRICHMENT. LEGAL CONSIDERATIONS AND PLANNING OF FUTURE POLICY. (Japan Atomic Industrial Forum, Inc., Tokyo). Translated by W. J. Grimes from a Japanese report. 12p. Dep. NTIS.

The fundamental law governing atomic energy in Japan is discussed in relation to its ability to enforce the protection of secrets related to uranium enrichment. The law's weakness is pointed out. Future planning and policies for protecting uranium enrichment technology are given. (TFD)

17457 URANIUM ENRICHMENT STUDY AND OTHER AIF PROGRAMS. Davis, W. K. (Atomic Industrial Forum, Inc., New York). At. Jap.; 16: No. 6, Suppl., 29-56(Jun 1972). (CONF-720341-6).

From 5th Annual Conference of the Japan Atomic Industrial Forum; Tokyo, Japan (22 Mar 1972).

A lecture by K. Davis, honorary director of the U.S. AIF, in the JAIF annual conference was given on the subject matter. First, activities of AIF are briefed, including licensing, public affairs, etc. Concerning uranium enrichment, studies made by the AIF enrichment committee, though not final yet, are described. The AIF feels that the U.S. and industrial firms are responsible for the continued supply of enriched uranium for the types of reactors developed, promoted and sold by the U.S. In this view, the following aspects of uranium enrichment are discussed: growth of nuclear power, requirement for uranium enrichment service, tails concentration, plutonium recycle, FBR's, supply and demand, implementation programs, schedules, and economic factors. It is concluded that the problem of additional enrichment capacity is urgent, and it has international implications requiring collaboration among concerned countries. (JA)

17458 METHOD AND FACILITY FOR THE SEPARATION OF A MIXTURE OF GASES OF DIFFERENT MOLECULAR WEIGHTS. Oyama, Y.; Takashima, Y.; Aoki, S. (to Power Reactor and Nuclear Fuel Development Corp.). German Patent 1,801,307. 30 Mar 1972. 4p. (In German).

The invention concerns a method for the separation of a mixture of gases of differing molecular weight, in particular uranium or uranium hexafluoride, in a centrifugal drum which is arranged in a casing and rotated. The gas mixture which is to be separated is fed into the centrifugal drum. The differently enriched parts of the gas mixture are drawn off the inner drum into distinct regions between casing and drum, where they are mixed individually with a gas of low molecular weight, e.g., He which was also blown into these regions. The differently enriched mixtures are then led from their respective regions to the outside of casing. A flow sheet shows the cascade arrangement of several centrifuge separation steps. (GF)

17459 UTILIZATION OF WASTE HEAT FROM POWER PLANTS FOR THE PRODUCTION OF HEAVY WATER. Kluge, H. (to Steinkohlen-Elektrizitaets AG). German Patent 1,767,700. 18 May 1972. 11p. (In German).

According to this invention the waste heat of a power plant operating with condensing water and utilizing condensing-water cooling towers and condensing-water circuits is used for the production of heavy water. For this purpose the steam-saturated cooling air of a cooling tower is utilized to remove the light-boiling H_2O-component of the additionally charged water in a drift column coupled at the outlet side. During this operation the D_2O is enriched in the coolant loop where it can be separated. Including the drift column with a condenser coupled at the outlet side into the extended mantle of the cooling tower, a cooling tower results which is constructed like a distillation column. (GF)

17460 PLANT FOR THE PRODUCTION OF DEUTERIUM-ENRICHED WATER. Kluge, H. (to Steinkohlen-Elektrizitaets AG). German Patent 2,048,117. 20 Apr 1972. 11p. (In German).

A plant for the production of deuterium-enriched water is described which is combined with a steam power plant and utilizes its waste heat. Several distillation towers are arranged in series, each consisting of drift column, water inlet above and heat exchanger below the drift column, intensifier with condenser connected at the outlet side. The first and the second heat exchangers are heated by means of the cooling water from the power plant, the last one is heated by low pressure steam from the power plant. The fresh water is fed into the first tower, the condensate is fed into the water inlet of the second tower, and so on until a condensate which is sufficiently enriched in deuterium can be drawn off the last distillation tower. (GF)

17461 METHOD FOR THE PRODUCTION OF DEUTERIUM. Pachaly, R. W. (to Gulf Research and Development Co.). German Patent 2,150,664. 4 May 1972. 25p. (In German).

The method described as the basis of the invention uses methane, natural gas, or other light hydrocarbons for the production of deuterium gas and, finally, heavy water. The initial compound is treated with hydrogen having a reduced deuterium content at higher temperatures in contact with a hydrogenation-dehydrogenation catalyst, and the obtained deuterium-enriched hydrogen stream is separated from the deuterium-poor initial compound. From the deuterium-enriched hydrogen gas practically pure deuterium is obtained by several coupled low-temperature fractionations, which then can be combusted with pure oxygen resulting in heavy water with more than 99% purity. (GF)

17462 PRESENT SITUATION IN URANIUM ENRICHMENT; QUESTIONS AND MEASURES. Ipponmatsu, T. (Japan Atomic Power Co., Tokyo). At. Jap.; 16: No. 6, Suppl., 3-10(Jun 1972). (CONF-720341-4).

From 5th Annual Conference of the Japan Atomic Industrial Forum; Tokyo, Japan (22 Mar 1972).

The problem of uranium enrichment in Japan is stated to be both complex and difficult. The capital investment, time and technology, and also power supply form the practical uranium enrichment problems. The status of uranium enrichment varies from one country to another. Nuclear power generation in Japan is expected to exceed 60,000 MW(e) by 1985, and its corresponding annual need for the enriched uranium will be about 8,000 tons swu. Japan's enrichment status is still in the R and D stage. The target date set for the completion of an enrichment plant with capacity of 5,000 tons swu per year is 1985. Technological development will be pursued on gaseous diffusion and centrifugal separation until about 1975. (JA)

17463 DEVELOPMENTS IN ISOTOPE SEPARATION. Frejacques, C. (CEA, Paris). At. Jap.; 16: No. 6, Suppl., 11-28 (Jun 1972). (CONF-720341-5).

From 5th Annual Conference of the Japan Atomic Industrial Forum; Tokyo, Japan (22 Mar 1972).

Recent French developments in isotopic separation are reviewed. Advantages and disadvantages of ^{10}B and ^{11}B as neutron absorbers are reviewed. Many processes for boron isotope separation have been studied, but up to now only one of them has been used on an industrial scale, i.e., separation by isotopic exchange between BF_3 and some of its complex organic compounds. The Isobore Society was established in 1968 and its plant started work in 1971. It can produce 200 kg/y of 90% ^{10}B. Its process is described. The French process using ammonia-hydrogen exchange, utilized at Mazingarbe plant, has already been described. Since then two additional plants of that type have been ordered by the Indian Government and are under construction at Baroda and Tuticorin. The Mazingarbe experience is reviewed briefly and the improvements accomplished in the Indian plants are described. Work on amine process is mentioned. Europe alone will need a uranium isotope enrichment capacity of about 20×10^6 swu for nuclear power generation by 1985. In this situation, research and development effort will be undertaken. The gaseous diffusion and centrifugal separation processes are reviewed. The recently established Japanese–French group will study the problems related to gaseous diffusion plants. (JA)

Isotopic Power Sources

17464 (DOCKET-701324-1) INTEGRATED WASTE MANAGEMENT SYSTEM RITE HEAT SOURCE. Application for a

Special Nuclear License. (General Electric Co., Philadelphia, Pa.) 24 Mar 1972. 175p. Dep. NTIS.

The special license application of the General Electric Company for possession for a period of 8 months of a Hastelloy-encapsulated 420 W $^{238}PuO_2$ heat source (RITE) for use in the Integrated Waste Management System in manned space vehicles is presented. The Integrated Waste Management System uses high-temperature processes for recovering sterile water from biological wastes and for incinerating solid wastes. The application details are: activities involved in test uses of the RITE heat source; design and operation of the Integrated Waste Management System; design of heat pipe; location of test and storage facilities at Valley Forge plant; heat source specifications; radiation protection standards and practices; design of RITE heat source shipping container; testing of heat source for spacecraft accident conditions; RITE program organization and qualifications of program personnel; shielding; instrumentation; containment, decontamination, and radiation monitoring equipment and methods; regular and emergency handling procedures; radiological safety reporting; and security operations involving RITE heat sources. (LCL)

17465 (N-72-28682) ADVANCED RTG AND THERMOELECTRIC MATERIALS STUDY. Final Report, January-October 1971. Eggers, P. E. (Battelle Memorial Inst., Columbus, Ohio). Nov 1971. Contract NAS5-11394. 86p. (NASA-CR-122431). NTIS.

A comprehensive, generalized two-dimensional radioisotope thermoelectric generator (RTG) analysis computer program was developed. This program is capable of analyzing any specified RTG design under a wide range of transient as well as steady-state operating conditions. The feasibility of a new concept for the design of segmented (or single-phase) thermoelectric couples was demonstrated. A SiGe–PbTe segmented couple involving pressure contacted junctions at the intermediate- and hot-junction temperatures was successfully encapsulated in a hermetically sealed bellows enclosure. The bellows-encapsulated couple was operated between a hot- and cold-junction temperature of 1200 and 450°K, respectively, with a measured energy conversion efficiency of 7.6 ± .5%. An experimental study of selected sublimation barrier schemes revealed that a significant reduction in the sublimation rate of p-type PbTe could be achieved by using multiple layers of SiO_2 fibers. A comparison of the barrier effectiveness is given for three different barrier designs. (auth)

17466 NUCLEAR BATTERY. Olsen, L. C.; Seeman, S. E.; Griffin, B. I.; Ambrose, C. J. (to McDonnel Douglas Corp.). U. S. Patent 3,706,893. 19 Dec 1972. Filed 19 Sep 1969.

A nuclear battery including one or more cells each comprising a radioactive fuel element or source and a semiconductor element positioned contiguously to the source and irradiated by it is described. The fuel element includes a radioactive material which is preferably ^{147}Pm metal or its oxide, promethia, and the semiconductor element includes a N^+/P or $N^+/P/P^+$ semiconductor wafer which is preferably silicon. The semiconductor wafer has an energy threshold of radiation damage which is compatible with the maximum energy of the nuclear particles or radiation emitted by the radioactive material, to provide a long-life (minimal radiation damage) cell of optimum power output. Other versions include a nuclear battery utilizing a bi-directional fuel element, and certain compact and useful embodiments utilizing a multiple section cell therein. (Official Gazette).

17467 REPLY TO $^{238}PuO_2$ AS A HEAT SOURCE FUEL. Taherzadeh, Mojtabe (California Inst. of Tech., Pasadena). Nucl. Technol.; 17: No. 2, 102-103(Feb 1973).

The reasons for differences between previously published analytical data on the neutron radiation level of $^{238}PuO_2$ heat source fuels currently being produced and neutron yield measurements on fuel produced at Mound Laboratory are explained. It is shown that by correcting the initial analytical calculations for the characteristics of the Mound Laboratory heat source, good agreement between the analytical and experimental data is obtained. (LCL)

17468 $^{238}PuO_2$ AS A HEAT SOURCE FUEL. Anderson, M. E. (Monsanto Research Corp., Miamisburg, OH). AT-33-1-GEN-53. Nucl. Technol.; 17: No. 2, 102(Feb 1973).

Discrepancies between previously published analytical data on the neutron radiation level of $^{238}PuO_2$ heat source fuels currently being produced and neutron yield measurements on fuel produced at Mound Laboratory are discussed. (LCL)

Radiation Sources

Refer also to abstracts 17201, 17396, 17408, and 17433.

17469 (BNWL-1308-12) PACIFIC NORTHWEST LABORATORY ISOTOPE DEVELOPMENT PROGRAMS QUARTERLY REPORT: AUGUST–OCTOBER 1972. Jarrett, J. H. (comp.) (Battelle Pacific Northwest Labs., Richland, Wash.). Nov 1972. Contract AT(45-1)-1830. 32p. Dep. NTIS.

Progress is reported in the following activities: technical and economic evaluation of using fission products Pd, Ru, Rh, and Tc; evaluation of large-scale uses of purified fission product Xe; encapsulation and compatibility of $^{90}SrFl_2$; development of portable sources for blood irradiation; radiation safety evaluation of radioisotope heat sources for circulatory support systems; development of low-flux neutron imaging technology; development of radioisotope heat source capsules; performance testing of seabed mineral analyzer; and cost studies of ^{137}Cs and ^{90}Sr recovery from radioactive wastes. (LCL)

17470 (MLM-1927) ^{239}Pu-Be NEUTRON SOURCE SURVEILLANCE AND TESTING. Madding, R.D. Jr.; Vallee, R.E. (Mound Lab., Miamisburg, Ohio). 15 Feb 1973. Contract AT-33-1-GEN-53. 45p. Dep. NTIS.

A series of ^{239}Pu-Be neutron sources was subjected to destructive and nondestructive tests. It was concluded that it was not possible, using techniques presently available, to assure integrity of the inner container. It is practical to determine that the outer container is sealed, although the quality of the weld joint cannot be assured. All the sample sources with a stainless steel outer container successfully passed the Department of Transportation special tests for special form. Two of the sources with a Vega steel outer container failed this series of tests one in an extensive fashion. Further use of selected sources is felt to be possible with a low degree of risk if the sources are qualified by the results of a series of NDT tests, reasonable restrictions are placed on their use, and periodic dimension, alpha wipe, and leak checks are made. Sources with Vega steel outer containers should not be used. A higher degree of assurance would obviously be obtained by providing the sources with an outer container using currently available quality-controlled fabrication procedures. It must be noted that the recommendations and conclusions can be applied directly only to Mound sources, the only fabricator represented in the destructive analysis and special test phases. (auth)

17471 (N-72-30600) EMITTED RADIATION CHARACTERISTICS OF PLUTONIUM DIOXIDE RADIOISOTOPE THERMOELECTRIC GENERATORS. Gingo, P. J.; Steyn, J. J. (NUS Corp., Rockville, Md.). Mar 1971. Contract NAS5-11359. 133p. (NASA-CR-122414; NUS-772). NTIS.

The nuclear and emitted radiation characteristics of the radioisotope elements and impurities in commercial-grade plutonium dioxide are presented in detail. The development of the methods of analysis are presented. Radioisotope thermoelectric generators (RTG) of 1575, 3468 and 5679 thermal watts are characterized with respect to neutron and gamma photon source strength as well as spatial and number flux distribution. The results are presented as a function of detector position and light element contamination concentration for fuel age ranging from "fresh" to 18 years. The data may be used to obtain results for given ^{18}O and ^{236}Pu concentrations. The neutron and gamma photon flux and dose calculations compare favorably with reported experimental values for SNAP-27. (auth)

17472 (UCRL-51298) SURVEY OF NEUTRON SOURCES AND THEIR APPLICATIONS. Lorenz, A. (California Univ., Livermore. Lawrence Livermore Lab). 30 Jun 1972. Contract W-7405-Eng-48. 25p. Dep. NTIS.

This survey is an introduction to the general characteristics and fundamental properties of neutron sources. The emphasis is on natural and isotopic sources, their uses and applications. Comprehensive tabulations of isotopic source reaction data and an ample bibliography are included. (auth)

17473 SAFETY AND THE USE OF SEALED RADIOACTIVE SOURCES. Chatelet, J. (Conservatoire National des Arts et Metiers, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl.; No. 93, 14-22(1972). (In French).

The hazards encountered when using sealed radiation sources are discussed. The regulations and normalization currently in force are presented. The ISO normalization project consists of defining the test specifications of the sources (temperature tests, external pressure tests, shock tests, vibration tests, and perforation tests), the classification of the use of such sources into 18 categories (medical, industrial, or scientific), and the leaktightness of the sources (a table of the control methods is presented). Conformity tests (in relation to the suggested norms) were carried out as well as tests on the compliance of specially shaped envelopes containing high activity sources. Complementary tests concerning orientation, fatigue endurance, and climatic endurance are cited. (FR)

17474 NUCLEAR PACEMAKERS. Carleson, J. G. (Aktiebolaget Atomenergi, Studsvik, Sweden); Kugelberg, J. Laekartidningen; 69: No. 30, 3497-3500(1972). (In Swedish).

It is expected that it will be possible to extend the period of operation of pacemakers to 10 years or more, if the present-day source of power (mercury cells) is replaced by a nuclear cell with the artificial radioisotope, plutonium-238, as the initial energy generator. The technical and clinical experience gained in prototype-development work in Europe, including Sweden, is presented and discussed in relation to the safety problems, for which internationally accepted solutions must be found before the nuclear pacemaker can be introduced onto the commercial market. (auth)

17475 ^{252}Cf PROGRESS, NUMBER 14, JANUARY 1973. Californium-252 Progr.; No. 14, 3-53(Jan 1973).

ACTIVATION ANALYSIS—neutron source for, evaluation of californium-252
CALIFORNIUM-252—uses of, review on developments in
—sales by USAEC through Dec. 1972
—information center on, establishment of
—shipping containers for, availability of
METALS—detection for pollution control, evaluation of californium-252 neutron source system for
MINERALS—exploration for, evaluation of californium-252 neutron source for
NEUTRON SOURCES—evaluation of californium-252, for industrial uses
NUCLEAR MATERIALS MANAGEMENT—safeguards system for, evaluation of californium-252 neutron source for use in
RADIOGRAPHY INDUSTRIAL—neutron source for, evaluation of californium-252
RADIOTHERAPY—neutron source for, evaluation of californium-252
REACTORS, THERMAL—neutron importance function in, use of californium-252 neutron source for measuring
SAVANNAH RIVER REACTOR MOCKUP—neutron importance function in, use of californium-252 neutron source for measuring
SHIELDED CONTAINERS—availability for shipping californium-252
SHIPPING—containers for californium-252, availability of
URANIUM DEPOSITS—exploration by delayed neutron logging, use of californium-252 neutron source for

17476 USE OF K-120 RESEARCH SOURCE FOR PILOT PLANT IRRADIATIONS. Stenger, V. (MTA Izotop Intezete, Budapest). Izotoptecknika; 15: No. 10, 485-492(Oct 1972). (In Hungarian).

The determination and causes of nonuniform absorbed doses by targets in the K-120 irradiation facility are reported. Uniform doses were obtained by proper rotation of the targets. (auth)

17477 PRODUCTION OF ALMOST MONOCHROMATIC RADIATION SOURCES FOR CALIBRATION PURPOSES IN THE RANGE OF 10 TO 300 keV. Ricci Piermattei, S.; Paganini Fioratti, M.; Casnati, E. (CNEN, Casaccia, Italy). pp 371-88 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The calibration of radiation instruments is particularly important in the range 10 to 300 keV. The different methods available for obtaining almost monoenergetic radiation sources in this energy range are discussed. The following sources of monochromatic radiations are examined: radioisotopes, heavily filtered x-ray spectra, and fluorescent radiation. The advantages and disadvantages of these methods are exposed. The production of fluorescent radiations is discussed from a theoretical point of view; the different parameters are examined and the results obtained are presented in the form of tables and graphs. (France)

17478 PASSIVE SOURCE OF SECONDARY RADIATION WITH A SOURCE-SHIELD GRID. Schmieder, R. W. (to United States Atomic Energy Commission). U. S. Patent 3,693,012. 19 Sep 1972. Filed 22 Jan 1971.

A secondary radiation source including a source-shield grid comprised of a thin layer of radioactive source material coated on one side of a grid of radioactivity shielding material, and a sample positioned facing the radioactive material is described. A radiation detector is positioned facing the shielding material. Radiation from the source material is unimpeded in the direction of the sample but is blocked from the detector by the shielding material. Radiation from the source material strikes the sample and excites it to emit secondary radiation characteristic of the sample. Open spaces in the grid provide a relatively unimpeded path from the sample to the detector. (Official Gazette)

17479 CALCULATION OF SHIELDING FOR RADIOACTIVE SOURCES. Standen, T. (Electricity Supply Commission, Johannesburg). S. Afr. Mech. Eng.; 63: No. 649, 178-187(Jun 1972).

The physical processes involved in attenuation of gamma radiation and how shield thicknesses and dose rates may be determined are described. Sufficient data are provided to enable the non-specialist to perform his own shielding calculations for simple source-detector geometries. Nomograms which can be used to give rapid approximate solutions of some of the shielding problems more commonly encountered are presented. (INIS)

Design and Fabrication

Refer also to abstract 17154.

17480 (BARC-629) FABRICATION OF PLUTONIUM-BERYLLIUM NEUTRON SOURCES. Mahajan, V. K.; Ganguly, C.; Ramakumar, M. S.; Roy, P. R.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 16p. Dep. NTIS (U. S. Sales Only).

The various fabrication steps employed in the production of 22 plutonium-beryllium neutron sources of varying strengths are described. (TFD)

17481 RADIOISOTOPIC SOURCE WITH A REGULATED RADIATION SPECTRUM. Meier, V. A.; Pshenichnyi, G. A.; Nakhabtsev, V. S.; Plotnikov, R. I.; Krotkov, M. I. Uch. Zap. Leningrad. Gos. Univ., No. 366, Ser. Fiz. Geol. Nauk; No. 22, 89-93(1972). (In Russian).

Designs for a regulated radiation source are presented which incorporate an α, β, γ or neutron emitter, an intermediate target, an absorber, and an outer protective container, and are intended for 2π or 4π geometry. A sample radiation spectrum is graphically depicted, employing ^{109}Cd as the emitter and a steel ring as an intermediate target. A second example is similarly described, using ^{170}Tm (Sm_2O_3) as the emitting source. (KSW)

17482 PROMETHIUM SOURCES. Parry, C.; Round, K. J. (to Atomic Energy of Canada Ltd.). U. S. Patent 3,711,326. 16 Jan 1973. Priority date 2 Aug 1968, Canada. 4p.

An apparatus and a method are described for the uniform deposition of the β emitting nuclide ^{147}Pm onto precisely defined areas. The technique both produces and deposits the emitting materials simultaneously without the need for separate preparation and purification of the metallic promethium. (Official Gazette)

17483 METHOD FOR SEALING THE CUTTING OR SEPARATION SURFACES OF RADIOACTIVE FOILS. Purt, G. A. (to Cerberus AG). U. S. Patent 3,710,537. 16 Jan 1973. Priority date 29 Mar 1969, Switzerland. 4p.

A method is disclosed for sealing or closing the cutting surfaces of radioactive foils covered at both sides with protective- or support layers formed of a noble metal, which comprises the steps of heating the foil for at least ten minutes to at least 60% of the absolute temperature of the melting point of the lowest melting protective- or support metal layer. (Official Gazette)

17484 ELECTRODEPOSITION OF ^{244}Cm FROM ETHANOL-ACETONE SOLUTION. Hardcastle, J. E.; Levine, N. E. (Univ. of Arizona, Tucson). Radiochim. Acta; 18: No. 1, 59(Dec 1972).

An electrodeposition method is described by which ^{244}Cm can be deposited in quantities up to 2 μg(or about 15 $\mu g/cm^2$) with a recovery of 96% and a reproducibility between samples of about 5%. While no quantitative study of plating conditions was done the ^{244}Cm deposits proved to be uniform and were suitable as fission fragment sources. (DHM)

Industrial Uses

Refer also to abstracts 17567 and 17704.

17485 (EUR-4953) CONDUCTIVITY MEASUREMENTS AS A METHOD FOR DIFFERENTIATION BETWEEN IRRADIATED AND NONIRRADIATED POTATOES. Scherz, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (West Germany). Institut fuer Strahlentechnologie). Feb 1973. Contract 047-69-4 PSTC. 24p. Dep. NTIS (U.S. Sales Only). EUR B.Fr. 40.-.

Irradiation causes a decrease of the conductivity of potatoes, which is dependent on the potato variety. It was further observed that with unirradiated potatoes the conductivity decreases immediately after sticking the electrodes into the tubers, until constant values of conductivity are reached after three minutes. This initial decline of conductivity is diminished by irradiation and disappears at doses above 50 krad. This effect of irradiation is nearly independent of variety and of storage conditions. It permits distinction between irradiated and unirradiated potatoes as long as the latter remain unsprouted. Tubers treated with the

chemical sprout inhibitor CIPC continue to show the initial conductivity decline even after 8 months of storage. When tubers that are unirradiated and not treated with CIPC begin to sprout, the initial conductivity decline is no longer observed. Apples, carrots, asparagus, Swedish turnips, white beets, and onions showed no consistent alteration of their conductivity by irradiation. (auth)

17486 FLUID IRRADIATOR AND PROCESS FOR ITS MANUFACTURE. Manning, B.; Nelson, S. E. (to Nuclear Associates, Inc.). U. S. Patent 3,705,985. 12 Dec 1972. Filed 27 Jun 1969.

A device is described for irradiating a fluid comprising a continuous tubular matrix in curvilinear form having a fluid inlet and a fluid outlet; a radioactive material dispersed substantially uniformly in the matrix to provide an annular radiation source; and a protective shield surrounding the matrix to prevent escape of radioactive energy to unwanted locations. A process for the preparation of a fluid irradiating article comprises in combination the steps of providing a material capable of being made radioactive; providing a porous tubular matrix which will have a half-life less than said material capable of being made radioactive when said matrix and said material are made radioactive by the same means for the same period; depositing said material substantially uniformly in at least a part of the porous portion of the porous tubular matrix; sealing at least the outer surface of the material containing tubular matrix to prevent escape of deposited material therefrom; and subjecting the resulting sealed tubular matrix to a means for making the deposited material radioactive. (Official Gazette)

17487 INDUSTRIAL GAMMA-IRRADIATION TECHNOLOGY WORKED OUT IN HUNGARY FOR THE STERILIZATION OF INJECTION NEEDLES OF SINGLE USE AND NON-TRAUMATIC WOUND-STITCHING NEEDLES. Igali, S. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Intezet, Budapest); Varteresz, V.; Antoni, F.; (and others). Izotoptechnika; 15: No. 10, 505-508(Oct 1972). (In Hungarian).

No deleterious biological effects from the use of irradiated medical needles and catguts were found. Sterilizing doses were determined by several methods and under several conditions. Handling procedures for the sterilized products are discussed. (auth)

17488 PROCESS FOR TEXTURISING AND STRUCTURISING PLANAR PRODUCTS. Bobeth, W.; Heger, A.; Passler, H. (to Forschungsinstitut fuer Textiltechnologie). British Patent 1,294,714. 1 Nov 1972. Filed date 16 Feb 1970. 4p.

A radiochemical method is described for permanent texturising or structurising products composed of high molecular weight polymer materials, particularly textile products. It allows colour patterning, and also advantageous clothing properties. The material is subjected, with the aid of a radiation-absorbing cover template, to local electron irradiation and before, during, or after irradiation is treated with hot air, hot water, or saturated steam which, in conjunction with the local action of the irradiation, leads to shrinkage that is different from that of the non-irradiated parts. The radiation-absorbing plate may be of Al, and the surface character of the product is determined either by the shape of apertures in the plate or by using moving absorbers. (UK)

17489 IMPROVING PLASTICS THROUGH IONIZING RADIATION. de Keersmaecker, G. Ingenieursblad; 3: No. 3, 65-69 (1973). (In Dutch).

Ionizing nuclear radiation completes the arsenal comprising heat, pressure, and catalytic agents that may be used by the chemist. A lot of manufacturers have introduced in production the use of particle accelerators and radiators for ameliorating plastics and electronic components. These means are also being used for ethyl bromide production and for sterilization of food products and medical instruments. A full range of new applications has already been thought of in the last past years, a few of which have been successfully marketed. A short review is presented of the energy transfer, radiation methods applied and both physical and chemical reactions in plastics, which are conducive both to ameliorating the materials and achieving the elastic memory. It concludes by dealing in short with products made from irradiated plastics and their field of application. (auth)

17490 AVOIDANCE OF THERMAL EXPLOSIONS AT FREE RADICAL POLYMERIZATION PROCESSES BY USING HIGH ENERGY IRRADIATION. Dobo, J. (Muanyagipari Kutato Intezet, Budapest). Izotoptechnika; 15: No.'10, 493-497(Oct 1972). (In Hungarian).

Gamma-ray chain initiation is a tool of increasing reaction rates while it eliminates the danger of thermal explosions at free radical polymerizations and other chain reactions. Its significance in industrial processes is expounded. (auth)

17491 PILOT PLANT EXPERIMENTS WITH THE IRRADIATION OF FOODSTUFFS AND FODDER AT THE BUDAPEST CENTRAL RESEARCH INSTITUTE OF THE FOOD INDUSTRY. Kiss, I.; Farkas, J.; Simon, J. (Kozponti Elemiszeripari Kutato Intezet, Budapest). Izotoptechnika; 15: No. 10, 518-525(Oct 1972). (In Hungarian).

The design and operation of a gamma irradiation facility for pilot plant experiments on the radiopreservation of foodstuffs and animal feeds are given. (auth)

17492 INDUSTRIAL PRODUCTION, IRRADIATION STERILIZATION, MICROBIOLOGICAL CONTROL OF PLASTIC EYE-DROPPERS EQUIPPED WITH LOCKING ELEMENTS. Derine, K. E. (Muanyagipari Kutato Intezet, Budapest); Somogyi, M. N.; Janovszky, I.; Stenger, V. Izotoptechnika; 15: No. 10, 509-514 (Oct 1972). (In Hungarian).

A method for radiosterilization of plastic eye-droppers is described. (auth)

17493 METHOD OF ELECTRON-MICROSCOPIC AUTORADIOGRAPHY. Chernikov, V. N.; Khruleva, L. S.; Zakharov, A. P.; Romanovskaya, K. M.; Luk'yanovich, V. M. This paper was summarized in At. Energ. (USSR); 31: No. 5, 509(Nov 1971) as paper No. 515/6171. (In Russian).

Full copy of this paper is held by TIC.

A brief review of the electron-microscopic autoradiography method is presented and its use in the investigation of metals is elucidated in detail. Special attention is devoted to the problems of preparing M emulsions (with average diameter of nondeveloped grains of AgBr equal to 0.14 μ), and to obtaining an emulsion layer of a given thickness on the investigated surface of the sample and in particular a monolayer of the emulsion. An interferometric method of controlling the thickness of the emulsion layer is proposed and the construction of devices for obtaining thin emulsion films is described. The characteristics of the monolayer of nuclear emulsion on the surface of the investigated sample are analyzed. In order to illustrate the potentialities of the method, results from the investigation of the structure of the two molybdenum alloys, Mo + 0.5% weight C and Mo + 3% weight ZrC, are presented (the isotope carbon ^{14}C was used as the radioactive indicator). (TFD)

17494 EFFECT OF RADIATION STERILIZATION ON THE STRENGTH OF THE SILK. Chekov, G. Khirurgiya (Sofia); 25: No. 1, 44-47(1972). (In Bulgarian).

The mechanical strength of industrially manufactured silk for surgical purposes sterilized in a chemical–thermal manner and by exposure to gamma-rays was studied. With the former method of sterilization the strength of the silk will be reduced by approximately 20% depending on the sterilization time; under the same conditions gamma sterilization will reduce silk strength by maximum of 7%. The practical importance and economic effects of gamma sterilization are great; it makes possible the use in surgery of silk with a one or two numbers smaller transverse diameter than the one used after chemical–thermal processing. This will provide maximal atraumatism, a minimal mass of foreign body in the organism, superior tolerance, decrease in the incidence of postoperative complications and a more rapid recovery process. (Abstr. Bulg. Sci. Med. Lit.)

17495 PRODUCTION AND USE OF SHRINKING POLYETHYLENE TUBES IN THE CABLE INDUSTRY. Kalman, I. (Muanyagipari Kutato Intezet, Budapest); Gyulassy, F.; Szechenyi, B. Izotoptechnika; 15: No. 10, 498-504(Oct 1972). (In Hungarian).

A method for radiation cross-linking of polyethylene tubes followed by their shrinking on cables is described. (auth)

17496 STIRRER AND RADIOACTIVE SOURCE FOR POLYMERIZATION REACTOR. Platz, G. M.; Palmer, W. H.; Mauck, J. W. (to National Distillers and Chemical Corp.). U. S. Patent 3,708,410. 2 Jan 1973. Filed date 13 Feb 1970. 10p.

A polymerization reactor is described having a hollow stirrer drum which is an elongated drum having apertures therethrough with paddles extending across the apertures. The stirrer drum is concentrically disposed about an elongated source of gamma radiation which serves as the energy source for a polymerization reaction of material introduced into the reactor. The stirrer drum divides the reactor into two concentric and approximately equal volumes, one internal of the stirrer drum and one external of the stirrer drum, with the material being stirred and intermixed between the two chambers through the paddle apertures by rotation of the stirrer drum. (Official Gazette)

17497 NUTRITIVE VALUE OF STORED FOODS AFTER GAMMA IRRADIATION. 3. NUTRITIVE TEST ON ^{60}Co-γ-RAY IRRADIATED POTATOES. Takai, Y.; Okada, S.; Iwao, H. (National Inst. of Nutrition, Tokyo). Kokuritsu Eiyo Kenkyusho Kenkyu Hokoku; No. 45, 71-2(Mar 1971). (In Japanese).

The optimum dose of ^{60}Co γ to potatoes for the purpose of preventing sprouting was found to be up to 15,000 rad. Potatoes irradiated with the γ radiation of different doses were mixed into the feed for infant male rats, and the influence on their growth rates and on apparent digestibility and absorption rates of proteins and carbohydrates were investigated. When calories from irradiated potatoes equal to five times as much as that of the normal daily diet of the Japanese population was administered to the rats every day, no influence was observed on the apparent growth of the animals, no difference was observed in liver constituents, and no differences in the apparent digestion and absorption rates of carbohydrates and proteins were observed. (Japan)

17498 USE OF IONIZING RADIATIONS TO INHIBIT THE SPROUTING OF POTATOES. I. TESTS ON THE PROLONGATION OF SHELF LIFE AND THE QUALITY OF BINTJE-POTATOES. Baraldi, D.; Guerrieri, G.; Miuccio, C. (CNEN, Rome). Ind. Conserve; 46: No. 4, 269-276(1971). (In Italian). (RT/BIO(72)56).

In order to compare the effect of preservation by chemical agents with that by irradiation, two sample groups of Bintje potatoes were irradiated with doses of 8, 5 and 10 krad respectively by using a ^{60}Co source; a third sample group was treated using 10 mg/kg of IPC/CIPC. The different sample groups were kept in a storage cell at 10°C and 85 to 90% relative humidity. During 10 months of storage physical, chemical, and technological determinations were carried out. Irradiation completely inhibited the sprouting and the potatoes were preserved in a good condition for a longer time than the chemically treated sample group. (auth)

17499 IRRADIATION SYSTEM. Rudolf, W. H. (to Sulzer Brothers, Ltd.). U.S. Patent 3,711,709. 16 Jan 1973. Priority date 10 Oct 1968, Switzerland. 8p.

The irradiation elements are disposed within a grid made of tubes and distributed across the cross-section of the vessel. The irradiation elements and tubes are oriented to obtain a uniform dose of radiation on the granular material passing through the vessel. The discharge hoppers and knife cylinders are arranged to achieve discharge rates therethrough commensurate with the radiation and flow resistance conditions. (Official Gazette)

17500 APPLICATION OF HIGH ENERGY RADIATION IN CHEMICAL TECHNOLOGY. Dobo, Janos (Muanyagipari Kutato Intezet, Budapest). Magy. Kem. Lapja; 27: No. 10, 497-503(1972). (In Hungarian).

The use of high-energy radiations in the chemical industry was reviewed. Following analysis of the industrial uses, it was concluded that there may be expected a further expansion of the use of independent radiation sources (accelerators and cobalt sources) in highly efficient reactions. Some technologically interesting features of radioinduced chemical reactions are treated. (auth)

17501 STUDY OF THE PREPARATION OF WOOD-PLASTIC COMBINATIONS. III. Preparation of Wood-Plastic Combinations by thermal Curing Method. Kim, J.; Lee, K. H.; Pyun, H. C. (Atomic Energy Research Inst., Seoul). J Korean Nucl. Soc.; 4: No. 4, 301-305(Dec 1972).

The polymerization rates of monomer or monomer mixtures impregnated with catalyst into domestic soft woods such as pinus densiflora, pinus rigida, and poplus deltoides were measured. The results were compared with those obtained by radiation curing method. The following conclusions were derived; pinus densiflora and pinus rigida are superior to the poplus deltoides, and methyl methacrylate (M.M.A.) is more effective than other monomers as far as the polymerization rates are only taken into account; the polymerization rate of vinyl acetate is generally slow. And the polymerization rate of the monomer is the slowest in case of being impregnated into poplus deltoides. However, the polymerization rate of the comonomer composed of vinyl acetate and M.M.A. is the fastest among the other monomers or monomer mixtures in woods regardless of the curing method; and the general trend of polymerization of monomers in wood is similar to that of monomers themselves in both curing methods if the woods do not contain much resin. (auth)

17502 STERILIZATION OF FOODSTUFFS BY IRRADIATION. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Zentralbl. Bakteriol. Parasitenk., Abt. I; 156: 157-170(1972). (In German).

Beginning with some remarks on the current public interest stimulated by the first petition for clearance of radiation-preserved foods in the Federal Republic, a review of the possibilities of radiosterilization and radiation-disinfestation of foods is presented; with special attention to microbiological aspects. (auth)

17503 SANITARY ASPECTS OF SELLING IRRADIATED FOODS. Lindner, K. Elelmez. Ipar; 26: No. 9, 263-268(Sep 1972). (In Hungarian).

The conditions required for obtaining permission from Hungarian public health authorities to sell irradiated foods are detailed. In general, the mass irradiation of potatoes to inhibit germination will be permitted when that technique is commercially available provided that further investigations show no public health hazards. (auth)

17504 RADIOSTERILIZATION OF MEDICAL PRODUCTS. II. Sterilization of Silk Sutures. Sato, K. (Tokyo Metropolitan Isotope Research Center); Kigawa, A. Ikakikaigaku Zasshi; 42: No. 5, 347-351(May 1972). (In Japanese).

A study was made on a method of measuring the number of bacteria on soft blade silk sutures before sterilization, their number and whether or not radiosterilization can be used for these sutures. Sutures thicker than 3 to 0 were cut into pieces of 5 to 10 mm and shaken in abluent solution 350 times per minute for 20 to 30 min so that bacteria might be washed out. The number of general living bacteria on the sutures was estimated by this method for more than one year, and the maximum number was 5×10^2/g. A relation between irradiation dose and bactericidal rate was examined about the sutures infected with Bacillus subtilis PCI 219 as marked bacteria, and the minimum dose for 100% bactericide was as low as 0.7×10^6 R. Bactericidal rate tended to be considerably lowered when sericin existed. One hundred percent bactericide was achieved by both BOG and autoclave methods under regular using conditions. (Japan)

17505 RADONA GAMMA IRRADIATION PLANT IN SWEDEN. Com. Naz. Energ. Nucl., Notiz.; 18: No. 11, 77-78(Nov 1972). (In Italian).

The gamma irradiation plant for the sterilizing of medical supplies which Radona Irradiations AB has in operation in Sweden is described. (auth)

LIFE SCIENCES

17506 (STI-PUB-(Vol. 13)) PEACEFUL USES OF ATOMIC ENERGY. Volume 13. Proceedings series. Proceedings of the fourth international conference held at Geneva, Switzerland, September 6-16, 1971. (International Atomic Energy Agency, Vienna (Austria)). Feb 1972. 510p. (In several languages). (CONF-710901-Vol. 13). IAEA $14.00.

From 4th International Conference on the Peaceful Uses of Atomic Energy; Geneva, Switzerland (6 Sep 1971).

Twenty-six papers discuss recently developed techniques using radiations and radioisotopes in medicine for diagnosis and therapy. Twelve papers discuss radiation damage and repair processes in animal cells relevant to radiotherapy. Separate abstracts, prepared for the individual papers, appeared previously in NSA. (CH)

17507 USE OF MATHEMATICAL PROCESSES IN BIOLOGY. Bacquet, H.; Demerle, P. (CEN, Fontenay-aux-Roses, France). pp 1049-63 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Mathematical techniques have been used for a long time in biology. However, it is only recently that techniques such as those used in physics are being used to study the intimate nature of biological phenomena, e.g., study of the behavior of ad hoc analogue models such as the theory of compartments applied to exchange phenomena involving diffusion and osmosis. If there are radioisotopes present in the substances exchanged, the radioactive decay further complicates the phenomena. The theory leads to formulations in terms of first order differential equations, which can be expressed in matrix form, and subsequently handled by computer. The field of genetics is very suitable for mathematical treatment as the studies concern a discrete variable such as the chromosome arrangements, genes, etc. leading to combinatorial analysis and probability and statistical treatments. Set theory can be used: the EDP and redundancy theories can be applied to problems involving the genetic code. The same theories are used to investigate radiation effects (target theory). The study of statistical correlations can aid investigations of the effect of external agents on living organisms and explain phenomena that could not be understood otherwise. A new science has been developed bionics in which living organisms are studied and mathematical techniques such as Boolean algebra used in order to design materials for industrial military or scientific purposes. (France)

17508 PHILOSOPHY BEHIND HEALTH PHYSICS: EDUCATION AND INFORMATION. Bocquet, H.; Dauteuil, R.; Giraud, R. (CEN, Fontenay-aux-Roses, France). pp 1065-82 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The philosophy behind the practical aspects of health physics must be capable of defining the personal qualities required of individuals working in the field and also the extent to which the public should be made aware of the existing problems. The different hazards presented by radiations involve various disciplines. The psychological and psychosociological aspects of the formation necessary are considered. The health physics officer must have sufficient knowledge of the relevant legislation and regulations, possess a high level of technical competence, and high personal qualities. He must comply with the regulations himself and inspire the confidence of other people. The information obtained must be presented honestly without attempting to hide the risks. It is emphasized that for the first time, problems concerned with the radioprotection of workers and the population are being dealt with on an international basis. (France)

Radiation Effects on Biochemicals

Refer also to abstracts 17567, 17621, 17622, 17635, and 17650.

17509 (AEC-tr-7397, pp 133-140) RADIATION OXIDATION OF CYTOCHROME C IN AN AQUEOUS SOLUTION. Amiragova, M. I. (Inst. of Biophysics, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 578-582(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The oxidation of cytochrome c in an aqueous solution under the influence of γ radiation was studied. The degree of oxidation is dependent on the initial concentration of ferrocytochrome c and is 2.3 molecules/100 eV when its level is $4 \cdot 10^{-4}$ M. It was ascertained using the method of competition with thymine that the rate constant for the reaction of cytochrome c with the OH-radicals is about $2.5 \cdot 10^{10}$ $M^{-1} \cdot sec^{-1}$. The high reactivity of compounds containing hemin with the OH-radicals was considered. (tr-auth)

17510 (AEC-tr-7397, pp 146-153) STUDY OF PRIMARY AND SECONDARY PARAMAGNETIC FORMATIONS IN γ-IRRADIATED SINGLE-STRAND DNA. Skvortsov, V. G.; Milinchuk, V. K.; Pshezhetskii, S. Ya. (Scientific Research Physicochemical Inst., Obninsk, USSR). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 587-592(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

It was established by the electron paramagnetic resonance method (EPR) that free radicals (primarily of pyrimidine bases) in single-strand DNA (SDNA) are formed as a result of photo- and thermoreactions of ion-radicals stabilizing in SDNA after radiolysis at a low temperature. There were no detectable differences in the nature of formation of primary and secondary paramagnetic centers (PC) and also in the corresponding EPR spectra in the SDNA in comparison with native DNA (NDNA). A correlation was found between EPR data and the results of a study of the radiothermoluminescence (RTL) of SDNA and NDNA. (tr-auth)

17511 (AEC-tr-7402, pp 22-30) ROLE OF SINGLE BREAKS IN THE DESTABILIZING ACTION OF IONIZING RADIATION ON THE SECONDARY STRUCTURE OF DEOXYRIBONUCLEIC ACID. Gamov, Yu. I.; Ivannik, B. P.; Simonov, V. V.; Yaskevich, A. G.; Aleinikova, T. L.; Poverenny, A. M.; Ryabchenko, N. I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 336-341(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The action of DNAase, ultrasound, and ionizing radiation on the stability of the secondary structure of DNA was investigated by the method of melting DNA at suboptimal temperatures in the presence of 2% formaldehyde. It was shown that the effectiveness of single breaks in the destabilization of the DNA structure is the same for all the agents studied. The data obtained permitted us to conclude that the radiation modification of nitrogen bases has no significant influence on the stability of the secondary structure of γ-irradiated DNA preparations. (tr-auth)

17512 (AEC-tr-7402, pp 31-40) DISTURBANCE OF THE THERMAL EQUILIBRIUM OF HIGH- AND LOW-SPIN FORMS IN HEMOPROTEINS DURING IRRADIATION. Manoilov, Yu. S.; Manoilov, S. E. (Inst. of Hematology and Blood Transfusion, Leningrad). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 342-347(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

Data are presented on the influence of x rays on various forms of hemoglobin. Investigations of the dependence of damage to oxyhemoglobin on the pH of the solution showed that after oxidation of iron, radiation breaks the heme-globin bond with the possible formation of free porphyrins. Under the influence of temperature, the oxidation of iron in heme in irradiated samples occurs at a high rate, and denaturation results at a lower temperature. A complex nature of the changes in the coordination group under the action of radiation on methemoglobin is noted. Various types of damages are considered: reduction of iron in heme, a change in the heme-globin bond, followed by the formation of free porphyrins. As a result of the use of highly sensitive spectral apparatus, a disturbance of the thermodynamic equilibrium state of high- and low-spin forms of methemoglobin during irradiation was detected. The role of such disturbances in the damage to the bioenergetics of the living organism as a whole is discussed. (tr-auth)

17513 (AEC-tr-7402, pp 72-79) EFFECTS OF UV RAYS ON MONOLAYER INTERFACES OF PHOSPHOLIPIDS. Tongur, A. M.; Volkova, M. S.; Pavlovskaya, T. E.; Baryshnikova, V. S. (Bakh Inst. of Biochemistry, Moscow). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 370-374(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The surface and barrier properties of nonirradiated and uv-irradiated monolayers of phospholipids of the cell nuclei of the calf thymus were studied. It was established that monolayers of phospholipids, forming an interface between the enzyme and the substrate, do not manifest the barrier properties observed in the case of monolayers of lipovitelline and DNP, studied under analogous conditions. Monolayers of phospholipids manifest an ability to increase the activity of enzymes. The action of uv rays intensifies this function of phospholipids. (tr-auth)

17514 (AEC-tr-7402, pp 80-89) INVESTIGATION OF THE INFLUENCE OF UV RADIATION ON THE COLLAGEN OF CON-

NECTIVE TISSUE OF ANIMAL SKIN BY THE ESR METHOD. Kipnis, A. B.; Azizova, O. A.; Levenko, P. I.; Shifrin, I. G.; Shekshеev, E. M. (Inst. of Biological Physics, Pushchino, USSR). Feb. 1973. Translated from Radiobiologiya; 12: No. 3, 375-381 (1972).

In Radiobiology, Vol. 12, No. 3, 1972.

It was shown that in the case of uv irradiation of dry collagen of cowhide, together with the formation of free radicals of aromatic amino acid residues, responsible for the absorption of uv light by collagen, free radicals of the peptide group, sensitized by aromatic amino acid residues, arise. The conversions of the paramagnetic centers arising at 77°K under vacuum under the action of visible light, heat, and air, are being studied. A possible mechanism of the formation of radicals of the peptide group and cleavage of the polypeptide chain of collagen is discussed. It was shown that when the samples are stored in air, free radicals remain for a long time. (tr-auth)

17515 (AEC-tr-7402, pp 112-119) PHOTOCHEMICAL ACTIVITY OF BUCKWHEAT CHLOROPLASTS IN CONNECTION WITH THE GAMMA IRRADIATION OF SEEDS AND VARIOUS CONDITIONS OF MINERAL NUTRITION. Guseva, V. A.; Kurganova, L. N. (Gorky State Univ., USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 396-400(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

It was shown that preplanting irradiation of buckwheat seeds at a stimulating dose of 500 R increases the photochemical activity of isolated chloroplasts of the plant leaf during ontogenesis; moreover, noncyclic photophosphorylation, coupled with the Hill reaction, and cyclic phosphorylation are increased. A direct correlation was established between the photochemical activity of the chloroplasts and the chlorophyll content. Favorable conditions of nutrition for buckwheat promote a better manifestation of the radiostimulation effect. (tr-auth)

17516 ANNUAL REVIEW OF BIOPHYSICS AND BIOENGINEERING. VOLUME 1. Morales, M. F. (ed.). Palo Alto, CA; Annual Reviews Inc. (1972). 597p.

A separate abstract was prepared for one review. Various aspects of biophysics and bioengineering are discussed in 18 additional reviews. (HLW)

For an abstract of an individual paper see: 17517.

17517 EFFECTS OF RADIATION ON POLYNUCLEOTIDES. Setlow, R. B.; Setlow, J. K. (Oak Ridge National Lab., TN). pp 293-346 of Annual Review of Biophysics and Bioengineering. Vol. 1. Morales, M. F. (ed.). Palo Alto, CA; Annual Reviews Inc. (1972).

The effects of radiation on biological systems are reviewed. Effects of ionizing radiation are discussed under the following headings: lethal and mutagenic effects; similarities to action of chemicals; the decay of incorporated radioactivity; measurement of chain breaks; rejoining of DNA strands in eukaryotes; rejoining of DNA strands in bacteria; lesions in bacteriophage and purified DNA; and repair replication, unscheduled DNA synthesis, and DNA breakdown. Effects of nonionizing radiation are discussed under the following headings: photoproducts induced in nucleic acids by uv radiation; sensitization by incorporated bromodeoxyuridine; sensitization by psoralens; dependence of photochemical reactions of DNA conformation; energy transfer; in vitro dark repair of uv-damaged DNA; photoreactivation; a DNA polymerase mutation and repair of uv-irradiated DNA; and post-replication repair of uv-irradiated DNA. (HLW)

17518 ENZYME INACTIVATION: THE BEHAVIOR OF ISOENZYMES, PARTICULARLY THE PEROXIDASES, UNDER THE INFLUENCE OF HEAT AND IONIZING RADIATION. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Dechema Monogr.; 70: No. 1327-1350, 265-77 (1972). (In German).

The varying inactivation behavior of isoenzymes, particularly the peroxidases, with their pronounced resistance to heat was studied. New methods of protein separation, especially thin-layer isoelectric focusing and thin-layer gel filtration, have made it possible to study the inactivation behavior of some 20 isoenzymes. Isoenzymes are most susceptible to heat at pI over 7.5. Aggregates are formed with molecular weights of more than 500,000, which only show traces of enzyme activity. With gamma radiation, on the other hand, aggregation appears to proceed gradually by way of dimers, trimers, etc., which display noticeable enzyme activity when compared to monomers. The alteration of the isoelectric pattern of monomers caused by radiation is not the same as that caused by heat. Whereas in an unirradiated isoenzyme mixture pIs of 3.7 to 8.4 occur, only monomers with pI 4.0 to 7.1 are found after irradiation with 2 Mrad. The isoelectric pattern of enzymatically active aggregates is basically different from that of monomers and produces pIs in the pH range of 4 to 6 only. Irradiation with microwaves shows the same effect on the isoenzyme pattern of horse-radish peroxidase as the usual treatment by heat. (GF)

17519 ELECTRON SPIN RESONANCE SPECTRA INTENSITY OF THE HUMAN HAIR. Studies on the Characteristics of ESR Spectra Intensity of the Human Hair, Especially the Individualities of Radiation Effects. Asai, Takuo; Shono, Yoshihiko (Radiation Center of Osaka Prefecture, Sakai, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 9, 1034-1047(Dec 1971). (In Japanese).

The ESR spectra of melanin reflect the molecular structure of melanin. The ESR spectra intensity of human hair was measured for a number of individuals and no obstacles were found in the hair to modify the spectra of melanin itself. The characteristics of the ESR spectra intensity were demonstrated as follows: individually specific to some extent, unchangeable through life, determined by heredity, and constituting a characteristic feature for each population group. Dose-effect relationships for the electron spin resonance spectra of melanin in human hair were determined following exposure to γ radiation. The structural difference of the hair melanin was so clearly defined for each subject that it may be considered as an almost individually characteristic feature. (auth)

17520 RADIATION-INDUCED CHANGES IN COMPOSITION OF ACID-SOLUBLE RAT SKIN COLLAGEN IN VITRO. Dancewicz, A. M., Majewska, M. R. (Inst. of Nuclear Research, Warsaw). Acta Biochim. Pol.; 18: No. 3, 283-287(1971).

Acid-soluble collagen from rat skin was irradiated in deaerated solutions at doses up to 80 krad and then subjected to disc electrophoresis, column chromatography on carboxymethylcellulose, and sedimentation analysis. Intramolecular and intermolecular (the more pronounced at higher dose ranges) crosslinks were formed and that, in turn, led to the formation of heavier aggregates. (auth)

17521 DEPROTEINIZED BONE POWDER AS A DOSIMETER FOR RADIOSTERILIZATION OF BIOSTATIC GRAFTS. Stachowicz, W. (Inst. of Nuclear Research, Warsaw); Michalik, J.; Dziedzic-Goclawska, A.; Ostrowski, K. Nukleonika; 17: No. 7-8, 425-31(1972).

A very stable electron spin resonance singlet appearing in deproteinized bovine bone powder under the influence of ionizing radiation is proposed as a measure of the absorbed dose. Standardized samples were irradiated in a ^{60}Co γ source of several doses ranging between 0.4 and 11.8 Mrads under the same experimental conditions. The dosimeter used for comparative dose evaluations was a ferrous solution (Fricke dosimeter). The intensities of the ESR signals in irradiated bone samples were compared with those of DPPH standard, and the spin concentration determined from this. A dose-dependent calibration curve of spin concentration in irradiated bone powder was obtained on the basis of the collected data. The standard deviation of the estimated doses in the range of 1.2 to 11.8 Mrads did not exceed 5.0%. It was concluded that deproteinized bone powder may be used as an alternative dosimeter for radiosterilization control in routine tissue bank practice. (auth)

17522 CHANGES IN THE DYNAMICS OF ACTION AND PHARMACOKINETICS OF SODIUM SALICYLATE IN IRRADIATION SICKNESS. Szczawinski, R.; Szczawinska, K.; Chodera, A. (Instytut Biologiczno-Farmaceutyczny, Poznan, Poland). Acta Physiol. Pol.; 23: No. 5, 829-837(1972). (In Polish).

The dynamics of changes in the potency of the analgesic and antiphlogistic action of sodium salicylate after exposure to ionizing radiation (300 and 600 R) were studied taking also pharmacokinetic investigations into account. In comparison with control animals, a rapid increase of analgesia was found in irradiated animals; the extinction of the analgesic action was also accelerated in these animals. An accelerated resorption and excretion of the drug corresponded to the above in pharmacokinetic analyses. The antiphlogistic action was more pronounced on the 1st and 6th day after exposure, and less strong than in controls on the 3rd day. A hypothesis was formulated according to which the thermoregulating centre possibly exhibited higher excitability at that time. (auth)

17523 BROMODEOXYURIDINE DEPENDENCE: A NEW MUTATION IN MAMMALIAN CELLS. Davidson, R. L.; Bick, M. D. (Harvard Medical School, Boston). Proc. Nat. Acad. Sci. U.S.A.; 70: No. 1, 138-142(Jan 1973).

When cells of a Syrian hamster melanoma were grown in increasing concentrations of bromodeoxyuridine (BrdU), lines of mutant cells able to grow well at high concentrations of BrdU were isolated. The mutant cells were characterized by BrdU dependence. In the absence of BrdU, the cells grew very poorly. The requirement for BrdU was specific for both the bromine and the deoxy sugar. The mutant cells incorporated BrdU into the DNA, replacing about 50% of the thymine residues with bromouracil. The reason for the BrdU dependence is not known. Effects of uv

radiation on DNA of BrdU-dependent cells were investigated. (auth)

17524 ULTRAVIOLET-STIMULATED DNA SYNTHESIS IN TOLUENIZED ESCHERICHIA COLI DEFICIENT IN DNA POLYMERASE I. Masker, W. E.; Hanawalt, P. C. (Stanford Univ., CA). Proc. Nat. Acad. Sci. U.S.A.; 70: No. 1, 129-133(Jan 1973).

Ultraviolet (uv)-stimulated nonconservative DNA synthesis was observed in E. coli rendered permeable to nucleoside triphosphates by exposure to toluene. This synthesis is detected in toluenized cells in which the background of uv-independent DNA synthesis is reduced by use of dnaB mutants temperature-sensitive for DNA replication and additionally deficient in DNA polymerase I. Uv-stimulated nonconservative synthesis is also seen in polA dnaE mutants that are deficient in two of the three known DNA polymerases. The observed uv-stimulated repair-like synthesis requires the presence of the four deoxyribonucleoside triphosphates and ATP. This mode of synthesis appears to differ from the ATP-independent nonconservative DNA synthesis previously reported to occur in toluenized bacteria. (auth)

17525 INHIBITION OF THE BIOSYNTHESIS OF DNA IN EHRLICH ASCITE CELLS USING RADIOLYSIS PRODUCTS OF URACIL AND THYMIDINE. Polverelli, M.; Cadet, J.; Teoule, R. (CEN, Grenoble, France). Compt. Rend., Ser. C; 275: No. 16, 917-920(16 Oct 1972). (In French).

Parabanic acid, 5-hydroxy-5-methyl-β-D-ribofuranosyl-2'-deoxybarbituric acid, 5,6-dihydro-6-hydroxythymidine inhibit the incorporation of ^{14}C thymidine in the DNA of tumorous Ehrlich ascite cells contained in vitro at concentrations between 10^{-3} M and 10^{-4} M. (France)

17526 X-RAY INACTIVATION OF THE ESCHERICHIA COLI DEOXYRIBONUCLEIC ACID DEPENDENT RIBONUCLEIC ACID POLYMERASE IN AQUEOUS SOLUTION. I. Studies on Binding and Substrate Concentration Dependence in the Inactivation of Enzymatic Activity. Strniste, G. F.; Smith, D. A.; Hayes, F. N. (Los Alamos Scientific Lab., NM). Biochemistry; 12: No. 4, 596-602(13 Feb 1973).

The x-ray inactivation of enzymatic activity of the DNA-dependent RNA polymerase isolated from three varying radiosensitive strains of Escherichia coli was examined using a variety of homopolymer templates and a natural double-stranded DNA. The radioresponse of enzymatic activity of the polymerase was independent of radiosensitivity of the cell from which it was extracted. Although the inactivation profiles obeyed single-hit exponential kinetics, the resultant D_{37} values obtained varied according to the template molecule used in the reaction assay. This variability in dose–response of the enzyme could not be attributed to binding of irradiated enzyme to the template molecule; the D_{37} values for inactivation of binding of irradiated polymerase to a poly(U) or poly(dT) template four to eight times greater than corresponding D_{37} values for inactivation of enzymatic activity of the polymerase using these two template molecules. When irradiated enzyme was assayed with homoribopolymer templates, there existed a substrate dependence in inactivation process (i.e., the D_{37} values for inactivation of enzymatic activity of the RNA polymerase changed as the substrate concentration in the reaction mixture was varied). With homodeoxyribopolymer templates, a substrate independence in inactivation curves was observed. Variation in average size of the template molecule did not influence inactivation of enzymatic activity of the x-irradiated RNA polymerase. Results strongly suggest that the initiation step in the catalytic process of RNA polymerization is the radiosensitive target. (auth)

Radiation Effects on Cells

Refer also to abstracts 17621 and 17635.

17527 (AEC-tr-7397, pp 82-92) CHANGE IN RADIOSENSITIVITY OF HeLa CELLS DURING PROLONGED CULTIVATION. Maksumova, Z. A.; Afanas'ev, G. G.; Pelevina, I. I. (Andizhan Medical Inst., Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 541-548(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

A study was made of the reaction of HeLa cells in the logarithmic and stationary growth stages to irradiation. During the stationary period there is a marked decrease in the number of dividing cells and cells synthesizing DNA; the dose curves of viability of cells irradiated in this stage are without "shoulders" and become exponential. However, the dose level D_0 does not differ from that for cells irradiated during the logarithmic period. The possible reasons for these differences are discussed. (tr-auth)

17528 (AEC-tr-7397, pp 192-198) MATHEMATICAL MODEL OF RADIATION INACTIVATION OF CELLS. Statistical Tests Method. Barsukov, V. S.; Lepekhin, A. F.; Malinovskii, O. V. (Ioffe Inst. of Physics and Tech., Leningrad). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 618-622(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The statistical tests method is used with an electronic computer in modeling the process of radiation inactivation of cells described as a result of competition of the processes of repair and fixation of radiation damage. The statistical tests method makes it possible to simulate the stochastics of occurrence of sublethal primary radiation damage to the cell during fixation of lethals and makes it possible to model a modification of the effect during the postradiation period. The results of computations on an electronic computer are represented in the form of an analog of the cell viability curve under the influence of sparsely ionizing radiations. (tr-auth)

17529 (AEC-tr-7402, pp 195-199) CHANGE IN THE RADIOSENSITIVITY OF SOC CELLS IN CULTURE DURING THE CELLULAR CYCLE. Komolov, I. S.; Gubin, V. A.; Samoylova, E. M.; Piskus, N. M. (Inst. of Biophysics, Moscow). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 451-453(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

In experiments on a synchronized culture of SOC cells, a substantial change in the radiosensitivity of the cells during the mitotic cycle was demonstrated. The minimum survival rate, determined according to Puck, was observed in the case of irradiation during mitosis and transition from the G_1 to the S period; the maximum survival is characteristic of the beginning of the G_1 and G_2 period. (tr-auth)

17530 RADIOSENSITIVITY OF CONFLUENT DENSITY-INHIBITED CELLS. Kim, J. H.; Kim, S. H.; Perez, A. G.; Fried, J. Radiology; 106: No. 2, 447-449(Feb 1973).

Dose/survival curves were obtained following x irradiation of plateau- and log-phase 3T3 and HeLa cells. The 3T3 line, whose proliferative behavior resembles that of normal tissue in certain respects, showed striking differences in radiation response according to the phase of growth. The neoplastic HeLa cell line exhibited much smaller differences. These findings may have potential radiotherapeutic significance. (auth)

17531 CHROMOSOME ABERRATIONS INDUCED "IN VITRO" BY IRRADIATIONS OF LOW LET IN HUMAN BLOOD CELLS. Feremans, W. (Centre P. Cogniaux, Brussels). J. Belge Radiol.; 55: No. 3, 365-384(1972). (In French).

Some human blood cells were irradiated using 200-keV x rays, gamma radiation from a ^{60}Co source, and a beam of 20- to 35-MeV electrons with the doses reaching several hundreds of rads. The biological responses under different experimental conditions were compared. Since it is a matter of chromosomal aberrations, whether it is a single dose or a double dose, the three types of radiation produce analogous results and the coefficients of production depend only on the dose. (tr-auth)

17532 RESPONSE OF HUMAN LYMPHOCYTES IN CULTURE TO X-IRRADIATION. Rudnicki, T.; Sloninska, B. (Zaklad Radiobiologii Instytutu, Poznan, Poland). Acta Physiol. Pol.; 23: No. 5, 809-822(1972). (In Polish).

Different aspects of the radiobiological response in human lymphocytes in asynchronous cultures in vitro versus the dose and time after irradiation were studied. Doses of 200 to 800 rads were used. The first evidences of radiation injury were interphase death and mitotic inhibition. Compete mitotic block was not observed. Abnormal mitoses and abundant chromosome aberrations were associated with disturbance of reproductive ability and polyploidy. It follows from these experiments that radiation can influence every phase of the generation cycle of human lymphocytes. It seems that the restoration of human lymphocytes in vitro from radiation injury is very restricted. (auth)

17533 REPAIR OF POTENTIALLY LETHAL RADIATION DAMAGE IN VITRO AND IN VIVO. Little, J. B.; Hahn, G. M.; Frindel, E.; Tubiana, M. (Institut Gustave Roussy, Villejuif, France). Radiology; 106: No. 3, 689-694(Mar 1973).

The repair of potentially lethal damage was studied in plateau-phase cultures of human LICH cells in vitro and in NCTC-2472 mouse fibrosarcoma grown in vivo in both the ascites and solid forms. Solid tumors and old, slowly growing ascites tumors repaired potentially lethal damage; the kinetics and amount of repair were similar to those found in plateau-phase cultures. Repair in vitro was associated with a change in the slope of the survival curve without an accompanying increase in the shoulder of the curve. The effects of repair of sublethal and potentially lethal damage were additive. Thus this repair is another factor that influences the response of tumors to fractionated irradiation. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 17066, 17504, 17570, 17621, and 17635.

17534 (AEC-tr-7397, pp 100-108) ANALYSIS OF THE RADIOBIOLOGICAL REACTIONS OF YEAST CELLS. Communication 3. Characteristics of Colonies Growing From Irradiated Yeast Cells. Kapul'tsevich, Yu. G.; Bliznik, K. M.; Korogodin, V. I.; Petin, V. G.; Kabakova, N. M. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 554-560(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

Characteristics of colonies growing from irradiated cells were studied. The size distribution of such colonies, appearing at different times after irradiation, agrees well with the hypothesis that large colonies grow from those cells that have received little or no damage, whereas small colonies grow from those cells receiving much damage (but less than the critical level). It was found that small colonies contain cells forming inactivation forms without irradiation and also differing in sensitivity to temperature and in radiosensitivity. Data on the effectiveness of cell growth from small colonies show that such cells, forming parts of the same colonies, should contain a different amount of damage. All this makes it possible to conclude that those concepts according to which different cell reactions to irradiation are unambiguously related to a definite amount of damage to corresponding targets cannot be used for explaining the entire body of results from radiobiological experiments. (tr-auth)

17535 (AEC-tr-7402, pp 120-128) INVESTIGATION OF THE RADIOBIOLOGICAL REACTIONS IN AMOEBA PROTEUS. Communication 1. Survival, Delay of Cell Division, and Forms of Death After Gamma Irradiation of Radiosensitive and Radioresistant Strains. Kharlamova, L. A. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 401-407(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The dose curves, dependence of the delay of division on the dose, and forms of inactivation were determined on two strains of Amoeba proteus: radiosensitive B and radioresistant C. The value of LD_{50} for the resistant strain was more than five times as high as for the sensitive strain. The delay of the first postradiation division was the same for the amoebas of the tested strains and increased linearly with the dose up to 120 kR, comprising 0.045 min/R. The strains of amoebas differ in the nature of postradiation death. The radioresistant strain proved more resistant in the case of irradiation with ultraviolet light. (tr-auth)

17536 (AEC-tr-7402, pp 129-140) ANALYSIS OF THE RADIOBIOLOGICAL RESPONSES OF YEAST CELLS. Communication 2. Forms of Inactivation and Postradiation Modification of Radiation Lesion. Kapul'tsevich, Yu. G.; Petin, V. G.; Korogodin, V. I.; Bliznik, K. M. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 408-415(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The purpose of the work included a verification of the possibility of explaining such peculiarities of the responses of yeasts to irradiation as the presence of various forms of inactivation and modification of radiobiological effects by conditions of postradiation culturing from the standpoint of the hit and target principle. This proved possible with the assumption that different forms of inactivation are determined by qualitatively different lesions, the critical number of which depends on the conditions of culturing, decreasing as these conditions deviate from the optimum. (tr-auth)

17537 (AEC-tr-7402, pp 141-153) PRINCIPLES OF THE FORMATION OF RADIORACES IN YEAST ORGANISMS. Communication 2. Patterns of Race Formation. Korogodin, V. I.; Bliznik, K. M.; Kapul'tsevich, Yu. G. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 416-424(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The diploid yeast Saccharomyces ellipsoideus Megri 139-B was irradiated at a dose of 35 or 70 krad and inoculated onto agarized wort. By collecting the modified colonies and repeatedly (over a period of two years) passing them on solid nutrient medium, the viability of the cells comprising them, the presence of hereditary changes, and the degree of stability were studied. It was shown that the radioraces may differ in degree of stability; this is expressed in a different frequency of appearance and in a variety of satellite races, as well as in the segregation of nonviable cells. The instability induced by irradiation in certain radioraces is observed over hundreds of cell generations. As a result of this, the process of race formation in yeast cells after a single irradiation is not always limited to the first divisions, but in a number of cases may continue for a long time. (tr-auth)

17538 (CONF-711148-) CELLULAR PROCESSES IN GROWTH, DEVELOPMENT, AND DIFFERENTIATION. Proceedings of a Symposium Held at Bhabha Atomic Research Centre, November 22-24, 1971. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 525p.

From Symposium on Cellular Processes in Growth, Development and Differentiation; Bombay, India (22 Nov 1971).

Separate abstracts were prepared for six of the 36 papers appearing in these proceedings. (ERB)

For abstracts of individual papers see: 17539-17543, and 17676.

17539 (CONF-711148-, pp 51-73) ALTERATION OF HOST RNA POLYMERASE DURING THE DEVELOPMENT OF BACTERIOPHAGE LAMBDA. Das, Asis; Biswas, B. B. (Bose Inst., Calcutta). 1971.

From Symposium on Cellular Processes in Growth, Development and Differentiation; Bombay, India (22 Nov 1971).

Attempts were made to elucidate any change that could occur in the transcriptional machinery during the development of bacteriophage λ. Pulse labeling of ^{3}H-Uridine into RNA during the induction of λ lysogens of E. coli K-12 revealed that a rifampicin resistant RNA polymerase activity appeared. Lysates prepared from induced lysogens of λ $CI_{857}S_7$ (wild in N gene) and λ $CI_{857}N_7$ (mutant in N gene) showed RNA polymerase activity resistant to rifampicin. Pulse labeling of ^{3}H-Uridine into RNA in the induced lysogens was not found when rifampicin was added before the start of induction. These results indicate that either a new RNA polymerase resistant to rifampicin appears or the host RNA polymerase, at least that protein subunit that confers rifampicin sensitivity, is altered during the late transcription of λ. Work is in progress to see which possibility is true and what gene of λ is responsible for this. (auth)

17540 (CONF-711148-, pp 109-117) INVOLVEMENT OF CELL MEMBRANE IN THE REJOINING OF RADIATION INDUCED SINGLE STRAND SCISSIONS IN DNA OF ESCHERICHIA COLI. Nair, C. K. K.; Ahya, A. A.; Pilgaokar, A. K.; Pradhan, D. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). 1971.

From Symposium on Cellular Processes in Growth, Development and Differentiation; Bombay, India (22 Nov 1971).

In view of the current findings that cell membrane could be associated with replication of bacterial DNA, it is of interest to ascertain whether repair of DNA in bacteria damaged by treatments such as irradiation, also involves cell membrane. Studies were carried out on effect of phenethyl alcohol (PEA), an agent believed to alter cell membrane structure, on rejoining of single strand breaks in DNA produced by ionizing radiations. Single strand scissions in DNA of E. coli B/r cells exposed to 20 krads gamma rays, as determined by alkaline sucrose density gradient sedimentation profiles of DNA prelabeled with ^{3}H-thymidine, could be substantially rejoined by incubation of irradiated cells in M.9 medium supplemented with casamino acids at 37°C for 1 hr. PEA (0.25%) completely prevented this repair. Removal of PEA resulted in complete restoration of the rejoining process. The action of PEA does not appear to be indirect due to interference in other cellular processes since this agent suppressed incorporation of labeled precursors into macromolecules only partially. The results indicate that enzyme(s) involved in rejoining of single strand breaks in DNA could be located at the cell membrane. (auth)

17541 (CONF-711148-, pp 143-156) MORPHOLOGICAL AND BIOCHEMICAL CHANGES DURING GERMINATION OF DORMANT BACILLUS SPORES. Nadkarni, A. R.; Kumta, U. S. (Bhabha Atomic Research Centre, Bombay). 1971.

From Symposium on Cellular Processes in Growth, Development and Differentiation; Bombay, India (22 Nov 1971).

While numerous studies have elucidated the sequence of events during germination, the biochemical reactions that break the dormancy of bacterial spores are not well understood. Spores vary greatly with respect to their specific requirements for germination conditions and germinants. In some refractive dormant spores, germination can be initiated by certain drastic physicochemical treatments. Under favorable conditions, spores undergo swelling followed by disappearance of cortex due to depolymerization and excretion of spore constituents, emergence, elongation, and cell division. It was observed that, unlike most other Bacillus spores, B. cereus BIS-59 spores (isolated from processed shrimps) exhibited superdormancy. This was revealed from its negative response to germinating agents such as alanine or glucose even after activation by heat or action of mercaptoethanol, alkali, and lysozyme for cleavage of spore murein. Addition of yeast extract or active fraction isolated from yeast extract stimulated germination. The degree of germination was determined using parameters such

as fall in optical density, increase in stainability, loss of refractility under phase contrast microscopy, and loss of heat and radiation resistance. The data on the kinetics of germination processes in B. cereus BIS-59 revealed marked differences from the germination characteristics of B. cereus (NCL, Poona) or B. megaterium QM-1551. (auth)

17542 (CONF-711148–, pp 157-165) COMMITMENT OF BIOCHEMICAL REACTIONS DURING ENDOTROPHIC SPORULATION IN AUTOLYTIC STRAIN OF BACILLUS LICHENIFORMIS BS-12. Gore, M. S.; Nadkarni, A. R.; Kumta, U. S. (Bhabha Atomic Research Centre, Bombay). 1971.

From Symposium on Cellular Processes in Growth, Development and Differentiation; Bombay, India (22 Nov 1971).

In studies on the growth characteristics, differentiation stages and radiation resistance of Bacillus species, the predominant survivors in shrimps given mild heat treatment for arresting melanosis, it was observed that one of the isolates identified as B. licheniformis BS-12 possessed high autolytic activity. It has been postulated that the lytic enzymes may have two diverse regulatory functions, one associated with liberation of spores from sporangia and the other in activation of germination process (Strange and Dark, 1957; Gould, 1965). Cells of B. licheniformis BS-12 in the logarithmic phase exhibited high autolytic activity as well as sensitivity to lysozyme at pH 6.8 with the liberation of aldolase, alanine dehydrogenase and pyrophosphatase. However, the cells suspended in citrate buffer, pH 2, for 2 hours and then transferred to phosphate buffer, pH 6.8, showed marked resistance to lysozyme and conservation of intracellular proteins as revealed by their absence in the supernatant. Phase contrast microscopy however, did not reveal structural alterations indicative of initiation of sporulation. These observations suggest that low pH treatment of the cells initiate development of lysozyme resistance as one of the early events occurring prior to onset of endotrophic sporulation. (auth)

17543 (CONF-711148–, pp 511-524) PROTEIN DISULFIDE REDUCTASE ACTIVITY IN SACCHAROMYCES CEREVISIAE SUBJECTED TO GAMMA IRRADIATION. Godbole, S. S.; Nadkarni, G. B. (Bhabha Atomic Research Centre, Bombay). 1971.

From Symposium on Cellular Processes in Growth, Development and Differentiation; Bombay, India (22 Nov 1971).

The cells of Saccharomyces cerevisiae exposed to gamma rays lost their ability to form colonies though they retained integrity to synthesize catalase, thus indicating relative sensitivities of cell division mechanisms and protein synthesizing systems respectively. The budding process in yeast cells has been correlated with a protein disulphide reductase acting specifically on the mannan-protein complex constituting the cell wall. Some of the characteristics of this enzyme, which has no resemblance to glutathione reductase, will be presented. This enzyme is associated with promitochondria in anaerobic cells. It has a sharp pH optimum of 7.1 and is inhibited by EDTA indicating involvement of a metal ion. The cells rendered more resistant to radiation by prior aeration had 2.5 times more activity of protein disulphide reductase. The results show that in addition to radiation induced inactivation of this enzyme in vivo, structural changes in the substrate protein could also affect the rate of budding. (auth)

17544 STUDY ON MUTATION OF BLACK MALT BACTERIA. 5. Mutation of Aspergillus awamori by gamma rays and its application. Arai, H. (Tokyo Univ.); Konno, K.; Makino, M. Nippon Jozo Kyokai Zasshi; 66: No. 4, 416-419(Apr 1971). (In Japanese).

Mutation caused by ^{60}Co γ radiation was investigated using black malt bacteria, Aspergillus awamori strain No. 1007, as the original strain. Conidia of the sample strain exhibited the same survival curve as Asp. usamii strain R-0635 and Asp. awamori strain BL-5-9. Mutation rates of the conidia increased in proportion to dose up to 1.0×10^5 rad. In relation to starch decomposing ability, one strain having one and half times as much titer as that of the original strain was obtained from the 6×10^4 rad applied group, while one mutated strain having twice as much acid forming ability as the original strain was obtained from the 8×10^4 and 6×10^4 rad applied groups. When the mutated strains with better acid forming ability were used for Shochu (a kind of distilled alcohol drink), good results were obtained in the increase of alcohol yield and in making 50% reduction of malt rate. (Japan)

17545 DOSE DEPENDENT STALK DIVISION IN GAMMA-IRRADIATED WHOLE ACETABULARIA CELLS. Bonotto, S.; Kirchmann, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Arch. Biol. (Liege); 83: 207-214(1972).

The unicellular uninucleate marine alga Acetabularia mediterranea is a very useful organism for research on cellular and molecular biology and particularly on radiobiology. Gamma radiations induce stalk division in whole (nucleate) but not in anucleate cells. Stalk division, which is a dose-dependent phenomenon, is very useful for the study of morphological differentiation in Acetabularia. In fact, in contrast with normal algae, which develop a single reproductive cap, branched Acetabularia form several reproductive caps. Generally, all the caps of branched algae become replete with cysts, a fact that suggests a possible relation between the cytoplasmic volume of the cell and the final number of secondary nuclei formed. (auth)

17546 LOSS OF PHOTOREVERSIBILITY OF UV-INDUCED MUTATION AND DNA REPLICATION IN ESCHERICHIA COLI B/r. Nishioka, H. (Tokyo Inst. of Tech.); Doudney, C. O. Bull. Tokyo Inst. Technol. (Engl. Ed); No. 109, 113-120(Mar 1972).

Loss of photoreversibility of uv-induced mutation to streptomycin resistance in Escherichia coli strain B/r occurred during the first 20 min of postirradiation incubation. The initial postirradiation replication of DNA that began after 40 min of incubation was significant in the mutation process since expression of streptomycin resistance (measured in streptomycin-containing agar medium blocking protein synthesis) does not occur unless DNA replication is allowed before plating and is thymine dependent with a thymine-requiring substrain. Loss of photoreversibility is unaffected by absence of tryptophan in an amino acid-requiring substrain or by absence of thymine in a thymine-requiring substrain but is blocked by dinitrophenol. These observations suggest that (i) excision of pyrimidine dimers results in gaps in the DNA single strands (accounting for the loss of photoreversibility in mutation) and (ii) repair-replication filling in the gaps occurs before semiconservative DNA replication with a certain probability for error resulting in mutation. A possibility of involvement of recombination repair process in causing mutation, interpreting our results of the rapid loss of photoreversibility prior to semiconservative DNA replication is discussed. (auth)

17547 DYNAMICS OF POLYNUCLEOTIDEPHOSPHORYLASE ACTIVITY IN LYSOGENIC AND NONLYSOGENIC STRAINS OF E. COLI UNDER CONDITIONS OF THE USE OF INDUCING AGENTS OF DIFFERENT NATURE. Kolobov, A. V.; Panchenko, L. F.; Abidova, M. (Moscow Medical Inst.). Byull. Eksp. Biol. Med.; 74: No. 11, 57-61(Nov 1972). (In Russian).

Polynucleotidephosphorylase activity was studied in E. coli K-12 (λ) E. coli B under conditions of irradiation of these microbes with 640-MeV protons, γ rays, ultraviolet rays, and mitomycin C treatment. It was shown that high-energy protons, γ and ultraviolet rays in certain doses caused an activation of polynucleotidephosphorylase in bacteria. A direct relationship was found between the increase in the activity of the enzyme and the incubation time (up to 60 min) following irradiation and treatment with the antibiotic of lysogenic and nonlysogenic E. coli strains. On the basis of the analogy in the dynamics of enzymatic activity in the strains the role of polynucleotidephosphorylase in the mechanism of induced development of a moderate λ bacteriophage is refuted. A supposition is put forward on the participation of polynucleotidephosphorylase in the mechanism of postradiation degradation of bacterial RNA. (auth)

Radiation Effects on Plants

Refer also to abstracts 17485, 17497, 17570, 17621, and 17635.

17548 (AEC-tr-7397, pp 58-64) MUTAGENIC EFFECT OF EXTRACTS FROM GAMMA-IRRADIATED POTATO TUBERS ON THE SEX CELLS OF MALE MICE. Kopylov, V. A.; Osipova, I. N.; Kuzin, A. M. (Inst. of Biological Physics, Pushchino, USSR). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 524-528 (1972).

In Radiobiology, Vol. 12, No. 4, 1972.

Peroral administration of radiotoxins (RT) isolated from potato tubers irradiated by γ rays in a dose of 10 KR to male mice induces dominant lethal mutations in the sex cells in the following stages: spermatozoids, 21.5%; spermatids, 22.2%; and spermatocytes, 21.06%. The similar fraction from unirradiated potato tubers causes an insignificant post-implantation death of the embryos at all the studied times (4.1%). The possible mechanisms of the effect of RT on DNA structure in sex cells are discussed. (tr-auth)

17549 (AEC-tr-7397, pp 117-125) KINETICS OF CELL MULTIPLICATION IN THE GROWING PARTS OF PEA SEEDLING ROOTS DURING GAMMA IRRADIATION. Gudok, I. N.; Grodzinskii, D. M. (Inst. of Plant Physiology, Kiev). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 566-572(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

A quantitative study was made of the kinetics of multiplication of cells in the meristem and in other zones of the growing part of roots of pea seedlings during γ irradiation. Irradiation in doses of 200 to 800 rad results in a decrease in the number of cells in the meristem by several times; this is a reversible process. With

irradiation in higher doses, the number of cells in the meristem decreased to such an extent that restoration became impossible. The dependence of root growth on the number of cells in the meristem and the influence exerted on this process by substances of different nature modifying the radiation effect are demonstrated. The mechanism of intercellular interactions in the growing part of the root under normal conditions and during irradiation is discussed. (tr-auth)

17550 (AEC-tr-7397, pp 126-132) EFFECT OF X IRRADIATION ON HYBRID TOBACCO SEEDS. Avakyan, V. A.; Nersesyan, P. M. (Lab. of Induced Plant Mutagenesis, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 573-577(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The radiosensitivity of hybrid tobacco plants was studied. Hybrid seeds of the first generation, as well as parent seeds, were subjected to x irradiation in doses of 5, 10, 15, and 20 KR. A specific reaction of the hybrid and its initial varieties to x irradiation was established. The hybrid obtained by crossing radiotolerant and radiosensitive varieties was radiotolerant. (tr-auth)

17551 (AEC-tr-7397, pp 176-178) INVESTIGATION OF THE REASONS FOR THE DIFFERENT RADIOSENSITIVITY OF INDIVIDUAL PLANTS. Ganassi, E. E.; Zaichkina, S. I.; Aptikaeva, G. F. (Inst. of Biological Physics, Pushchino, USSR). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 607-609(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The post-radiation effect of caffeine on the occurrence of chromotidal aberrations in the root cells of individual Vicia faba plants was studied. Intensification of damage by caffeine increases with an increase in the radioresistance of plants. This indicates that the variability of radioresistance of individual plants is related to differences in post-radiation repair processes. (tr-auth)

17552 (AEC-tr-7397, pp 185-191) POSSIBLE CORRELATION OF THE MODIFYING EFFECT OF SUPEROPTIMUM TEMPERATURES AND THE OXYGEN EFFECT IN THE X IRRADIATION OF SEEDS. Babayan, R. S. (Lab. of the Induced Mutagenesis of Plants, Erevan). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 613-617(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The possible correlation between the protective effect of superoptimum temperatures and the oxygen effect during the x irradiation of wheat and barley seeds was studied. Anoxia exerts no effect on the magnitude of the protective effect caused by heating prior to irradiation. With joint exposure to anoxia and heating the protective effect is equal to the sum of the individual factors. This indicates that the protective effect of preradiation thermal effects is not associated with changes in the oxygen concentration in seed cells. (tr-auth)

17553 (AEC-tr-7402, pp 154-162) INFLUENCE OF POST-IRRADIATION STORAGE ON THE MUTATION PROCESS AND GERMINATION OF LETTUCE SEEDS (LACTUCA SATIVA), IRRADIATED WITH THE GAMMA RAYS OF ^{60}Co. Pap'yan, N. M.; Nevzgodina, L. V.; Orlova, N. N. Feb. 1973. Translated from Radiobiologiya; 12: No. 3, 425-430(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The work was conducted on lettuce seeds (Lactuca sativa), irradiated with γ rays at doses of 0.25 to 5.0 krad and stored for 43 days under various conditions. It was shown that storage of the irradiated seeds under conditions accelerating their natural aging leads to an intensification of the radiation-induced mutation process. Storage of the seeds under conditions inhibiting the aging process practically does not change the level of the original radiobiological lesion. (tr-auth)

17554 (AEC-tr-7402, pp 215-219) ROLE OF ENDOGENOUS SUBSTANCES IN DIFFERENCES IN THE RADIOSENSITIVITY OF DIPLOID AND AUTOTETRAPLOID BUCKWHEAT. Dovzhenko, L. I.; Korchak, L. I.; Zakaryan, M. S. (Inst. of Developmental Biology, Moscow). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 464-467(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

It was shown that the content of SH groups in the embryos of dormant seeds of 4x buckwheat is greater than in embryos of 2x seeds; sprouts of these types are equal with respect to this index. This corresponds to an increased radioresistance of the 4x form in comparison with 2x in dormant seeds and the same radiosensitivity of them when the seedlings are irradiated (the criterion was the frequency of chromosome rearrangements per genome). (tr-auth)

17555 (AEC-tr-7402, pp 220-226) PROTECTIVE ACTION OF CERTAIN RADIOPROTECTORS IN ACUTE AND PROLONGED GAMMA IRRADIATION OF PLANTS. Gudkov, I. N. (Inst. of Plant Physiology, Kiev). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 467-471(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The protective action of AET, cysteamine, cysteine, thiourea, hydroxylamine, ferric chloride, and manganese chloride in the γ irradiation of pea seedlings at the dose rate 1596 and 15 rad/min and in the case of fractionated irradiation was studied. It was shown that prolonged doses lower the degree of effectiveness of the radioprotectors, and on the contrary, with increasing effectiveness of the radioprotectors the level of recovery processes determined by prolongation is reduced. It is concluded that the processes of protection and recovery in the presence of radiation lesion are interrelated. (tr-auth)

17556 (ORO-1747-19) RADIATION GENETICS AND RADIATION RESISTANCE IN PEANUTS. Progress Report, November 1, 1971-October 31, 1972. Emery, D. A. (North Carolina State Univ., Raleigh). 1972. Contract AT(40-1)-1747. 14p. Dep. NTIS.

NC 4, a Virginia-bunch peanut variety, four radioinduced macromutants acquired from it and the 10 possible hybrid combinations were grown in three day-night temperature regimes of 34/30, 30/26 and 26/22°C. General combining ability estimates were higher than specific combining ability estimates for most reproductive characters. High specific combining ability was noted for individual crosses at low and intermediate temperatures. Selection for yield in control hybrid, prehybrid-irradiated and posthybrid-irradiated populations of the same cross continued by selecting the 12 highest yielding F_1 families (out of an original 55 F_1 families) and the five highest yielding F_2 families within F_1 families (out of the original 10 F_2 families per F_1 family). In this manner a total of 550 F_2 families per population has been reduced to 60 F_2 families per population. Measurements in the F_3 generation indicate that the highest yielding individual F_1 families occur in the control hybrid and prehybrid-irradiated populations. Families in posthybrid-irradiated populations were generally low yielders. The control and irradiated hybrid bulk population do not currently compete with commercial strains of peanuts but represent a dynamic reservoir of germplasm. (auth)

17557 (ORO-1747-19(App. A)) EFFECT OF TEMPERATURE ON EXPRESSION OF HETEROSIS AND COMBINING ABILITY IN CROSSES AMONG RADIATION-INDUCED MACROMUTANTS OF CULTIVATED PEANUTS (ARACHIS HYPOGAEA L.). Carlson, S. K. (North Carolina State Univ., Raleigh). 1972. 77p. Dep. NTIS.

Thesis.

NC 4, a Virginia-bunch peanut variety, four radioinduced macromutants acquired from it, and the 10 possible hybrid combinations (diallel cross among macromutants and NC 4) were grown in three day-night temperature regimes of 34/30°C, 30/26°C, and 26/22°C. Plants were grown for 71 days in 9 hr photoperiods during which data were taken on 12 reproductive and 7 vegetative characters. The control (NC 4) reached its maximum reproductive and vegetative development at the high temperature regime, while the radioinduced macromutants excelled in the intermediate temperature. Expressions of heterosis (midparental value and percent of control) were maximized when hybrids were grown at low temperature. While the combination with the greatest heterozygosity produced the greatest amount of heterosis at low temperatures, other combinations did not show a consistent relationship of number of heterozygous genes and heterosis. General combining ability estimates were higher than specific combining ability estimates for most reproductive characters. One mutant was particularly high in general combining ability effects for peg production and pegging efficiency. For each specific environment in the low and intermediate temperature regimes, there was a particular cross having high specific combining ability effects for seedling vigor. (auth)

17558 (ORO-1747-20) RADIATION GENETICS AND RADIATION RESISTANCE IN PEANUTS. Final report. Gregory, W. C.; Emery, D. A. (North Carolina State Univ., Raleigh). 1972. Contract AT(40-1)-1747. 17p. Dep. NTIS.

The major experiments included studies of the comparative effects of radiation upon genetic variability and progress from selection in different genotypes and hybrids; the selection for radioresistance; the breeding value of the macromutant; the use of irradiation in the breeding cycle of self-pollinated plants and a mutation breeding model. Supporting investigations were of the effects of low dosage irradiation and dormant seed moisture on seedling response. All of the research pertained to the application of irradiation and the resulting mutants to the improvement of cultivated plants through breeding. While the results from specific experiments conducted with limited germplasm in particular growing seasons cannot be generalized, certain broad conclusions may be reached. In all experiments the use of irradiation increased genetic variability in certain quantitative traits but the increases in variance were usually associated with decreased means unless

selection was practiced. Selection for radioresistance seemed to be effective to a point where accumulated radiation damage caused a shift to increased sensitivity. The use of macromutants with known genetic backgrounds may be one means of increasing selection potential for specific traits among the segregates. Bulk hybrid populations combined with irradiation to increase mutations and outcrossing could serve as continuing sources of new germplasm; irradiation applied to parents prior to hybridization gave greater selection potential for yield than post-hybrid treatments. (auth)

17559 MONOTELOSOMIC ADDITION OF RYE CHROMOSOME 3R TO TRITICUM DURUM. Rao, M. V. P. (Bhabha Atomic Research Centre, Trombay, India). Curr. Sci. (India); 41: No. 24, 888-9(20 Dec 1972).

A chromosome of rye was found to contain a gene for resistance to stem rust and crosses were made with wheat susceptible to stem rust. The wheat progeny were selfed and the frequency of resistant plants was determined. When the seeds of the progeny were treated with gamma radiation or thermal neutrons the frequency of resistant plants was reduced. Experiments using radiation were conducted to induce transfer of the rye gene for stem rust resistance to a wheat chromosome. (HLW)

17560 STABILITY OF GRAIN YIELD IN SELECTED MUTANT OAT LINES (AVENA SATIVA L.). Pacucci, G. (Univ., Bari, Italy); Frey, K. J. Radiat. Bot.; 12: No. 6, 385-397(Dec 1972).

Oat lines selected for seed weight and plant height from mutagen-derived (by treatment with thermal neutrons or ethyl methanesulfonate) populations of Beedee and Clintland cultivars and from the Beedee x Clintland cross were tested to measure the effectiveness of selection and their production stability for grain yield. Except in the tall-plant group, all traits selected showed heritability values around 50%. Production stability of selected and unselected lines for yield was measured by computing 3 stability parameters, mean grain yield (μ), the regression coefficients of the yields of a line on to mean yields of the environments in which the line was tested (B), and the variance of deviations-from-regression (σ^2_{di}). In general, grain yields were positively associated with the regression coefficients. Selected lines from mutagen-derived populations showed a greater variability of regression values than did the lines from untreated populations. Lines selected from mutagen-derived populations for small or large seeds and tall or short height, however, tended to have lower yields and reduced regression values, i.e., lines that carried mutations for seed weight or height also carried mutations for other plant traits, indicating that mutations were induced in clusters. (auth)

17561 EFFECT OF X RADIATION ON PLASTID DIFFERENTIATION IN PRIMARY LEAVES OF BARLEY. Sprey, B. (Kernforschungsanlage, Juelich, Ger.). Radiat. Bot.; 12: No. 6, 399-405(Dec 1972).

The effect of high exposures of x rays (100 to 500 kR) on etioplasts in primary leaves of barley irradiated in the dark was studied after illumination with white fluorescent light (10 kLux). Dose dependent changes in thylakoid number, chlorophyll content, production of ^{14}C-labeled intermediates of the Calvin cycle and nucleic acid content were found. The inhibition of chloroplast development is discussed on the basis of radioinduced changes in the synthesis of nucleic acids in plastids. (auth)

17562 VARIATION FOR SOME CHARACTERS IN COWPEAS, VIGNA UNGUICULATA (L.) WALP FOLLOWING IONIZING RADIATION. Ojomo, O. A. (Inst. of Agricultural Research and Training, Ibadan, Nigeria); Chheda, H. R. Radiat. Bot.; 12: No. 6, 373-380(Dec 1970).

The genetic variation for yield, pods per plant, and time to flowering in two varieties of cowpeas, "Westbred" and "Local Brown," was studied in the M_3 generation following radiation with x rays and thermal neutrons. The materials were planted in double row plots with two replications. Analysis of data showed that the genetic variance in irradiated populations were higher than in the control, in the range of 1.2 to 8 times. "Local Brown" had higher variability than "Westbred" following ionizing radiation; this was attributed to the more primitive evolutionary status of "Local Brown." The means of irradiated and control populations of the two varieties were not significantly different except for yield of "Westbred" and time to flower of "Local Brown" where means of irradiated populations were lower and higher than the respective control populations. By using pods per plant as a selection index, it was possible to make selections from irradiated populations of "Westbred," which on the average yielded higher than similar selections from the control population. (auth)

17563 INACTIVATION OF CONIDIOSPORES AND MYCELIA OF ASPERGILLUS FLAVUS BY γ-RADIATION. Mohyuddin, M.; Osman, N.; Skoropad, W. P. (Nuclear Inst. for Agriculture and Biology, Lyallpur, Pakistan). Radiat. Bot.; 12: No. 6, 427-431 (Dec 1972).

Inactivation of non-germinated conidiospores and mycelia of various ages of Aspergillus flavus was studied in relation to gamma radiation doses ranging from 25 to 200 krads. The survival curves of nongerminated conidiospores showed an initial shoulder region followed by an exponential region. To obtain mycelia, the spores were incubated in Czapek liquid medium for 6, 12, 24, 36, 48, and 60 hr on a shaker and radiation response studied by subjecting a known number to γ radiation. Mycelia of 6 hrs was very sensitive to radiation damage as compared to nongerminated spores or mycelia of various ages. The survival started increasing along with the period of incubation. The survival was maximum (70 percent at 125 krads) for the mycelium obtained after 60 hr of spore incubation. Mycelia obtained after 6 to 24 hr of incubation of spores were found most suitable for determining radiation inactivation on a nearly per cell basis. Extension of incubation period beyond 24 hr resulted in an intertwining of hyphae and this hindered an evaluation of radiation resistance on a per cell basis. (auth)

17564 MODIFICATION OF THE EFFECTIVENESS OF FISSION NEUTRONS VERSUS ^{60}Co GAMMA RADIATION IN BARLEY SEEDS BY OXYGEN AND SEED WATER CONTENT. Conger, B. V.; Carabia, J. V. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Radiat. Bot.; 12: No. 6, 411-420(Dec 1972).

Himalaya barley seeds (caryopses) were adjusted to different water contents ranging from 2.2 to 32.0%. Seeds ranging from 2.2 to 13.0% were irradiated in vacuo with varying doses of ^{60}Co γ radiation or unmoderated fission neutrons and then soaked in oxygen- or nitrogen-bubbled water for ~18 hr at 0°C. Seeds ranging from 19.7 to 32.0% water contents were irradiated without oxygen control at ~5°C and soaked in air-bubbled water after irradiation. The relative biological effectiveness (RBE) of fission neutrons compared to ^{60}Co γ radiation for seedling growth reduction varied depending on the water content of the seeds and the post-irradiation soaking atmosphere. Fission neutrons were 54 to 60 times more effective than γ radiation in seeds 2.2 to 13.0% water soaked in nitrogen-bubbled water after irradiation. For seeds soaked in oxygen-bubbled water after irradiation, fission neutrons were 7.6 times more effective than γ radiation in seeds of 2.2% water content. As the seed water content was increased to 13.0% the RBE increased to almost 60. As the seed water content was increased still further to 19.7, 24.5, and 32.0%, the RBE decreased so that at the highest water content, fission neutrons were only 7.5 times more effective than γ radiation. Nuclear volume also increased with increasing seed water but probably not enough to account for the large increase in radiosensitivity. The additional water per se, especially that in the embryo, may be the most important factor influencing radiosensitivity, especially to γ radiation. (auth)

17565 VACUOLAR INCLUSIONS AND CONDENSED NUCLEI IN THE SHOOT APEX OF MAIZE AFTER γ IRRADIATION. Graham, E. T. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Radiat. Bot.; 12: No. 6, 407-409(Dec 1972).

The anatomy of cells in maize shoot apices 24 hr after exposure to acute lethal γ radiation was studied in the electron microscope. Large, dense, intricately formed, vacuolar inclusions developed in many interphase cells of the apical meristem, leaf primordia, and youngest adjacent leaves. Similar but much smaller and fewer vacuolar bodies were observed in controls. Condensed nuclei were observed only in irradiated cells and then only in the apical meristem in contrast to the much wider occurrence of anomalous vacuolar inclusions. (auth)

17566 VARIABILITY OF THE QUANTITATIVE CHARACTER OF MAIZE AFTER CHRONIC IRRADIATION OF HYBRID GENERATION F_1. Cerny, J.; Stehno, Z. (Agricultural Univ., Prague). Genet. Slechteni; 8: No. 1, 37-46(Jan 1972). (In Czech).

Plants of the F_1 generation of hybrid maize were irradiated chronically by γ rays at a dose from 1969 to 175 R. The radiation intensity varied from 0.714 to 0.063 R/hour. The effect of the various doses on the variability of quantitative characters in F_3 hybrid generation was examined. Chronic irradiation of plants in F_1 generation increased both the phenotypical and genotypical variability of the following characters in F_3 hybrid population: number of leaves per plant, length of plants, thousand-kernel weight, and length of heads. In most characters the maximum increase in variability was observed at doses from 1969 to 902 R. Chronic irradiation of hybrid plants in F_1 generation induced a shift of the average values of F_3 generation, opposite to the selection in a previous generation. The influenced F_3 populations included classes with both lower and higher values of characters in comparison with the control F_3 population. This made it possible

to achieve a higher response to the selection of quantitative characters. (NSA of Czech.)

17567 IRRADIATION OF FRUITS AND VEGETABLES. SPROUT INHIBITION AND FRUIT RIPENING. Ogata, K.; Chachin, K. (Osaka Prefectural Univ., Sakai, Japan). Kagaku To Seibutsu; 10: No. 4, 234-42(Apr 1972). (In Japanese).

Control of sprouting of onions and potatoes by γ irradiation was confirmed and put into practice in Japan. Dose required for controlling the sprouting of both onions and potatoes is about 10 krad, and higher dose rates give best results. Onion sprouts are sometimes spoiled by radiation and hypertrophic cells are observed microscopically in potato terminal sprouts. Influences of plant hormone and nucleic acid metabolism can be the cause of sprout control. Also the irradiation sometimes causes changes producing brown color of potatoes and prevention of this change has been studied. Climacteric rise of respiration was observed in irradiated bananas and pears during ripening, but ripening was controlled satisfactorily. It was concluded this method might also be applied to non-climacteric fruits. Promotion of ethylene formation in the irradiated fruits is discussed, as well as the influence of irradiation on the respiration of tissue slices and cell granules. (Japan)

17568 MUTATION INDUCTION IN TOMATO (LYCOPERSICON ESCULENTUM MILL.) BY COMBINED TREATMENTS WITH X-RAYS, COLCHICINE, AND DIETHYL SULPHATE. Bose, S.; Maiti, S. N. (Univ. of Calcutta). Indian J. Exp. Biol.; 10: No. 4, 324-325(Jul 1972).

Dry seeds of the tomato variety "Best of All" were given post-x-irradiation treatment with distilled water (DW), colchicine, and diethyl sulphate, for 24 hr in each case. Mutants were observed affecting plant habit (creeping, dwarf, dwarf modified, dwarf sterile, extreme dwarf, and slender stem), leaf characters (drooping, necrotic, ridged, wiry, twisted, unipinnate and yellow foliage), flower characters (fasciated, macrocalyx and blind) and fruit characters (fasciated). Dwarf sterile, extreme dwarf, necrotic, slender stem and unipinnate mutants were either sterile or failed to produce fruits and seeds. The other mutants, on crossing with the normal plants, segregated in a 3:1 ratio showing recessive nature of the mutants. (auth)

17569 INFLUENCE OF IONIZING RADIATION ON THE CYTOGENETIC ACTIVITY OF SUBSTANCES OF THE ROOT MERISTEM OF VICIA FABA. Medvedev, A. I.; Ladygina, V. G. (Inst. of Biological Physics, Puschino-na-Oka, USSR). Dokl. Akad. Nauk SSSR; 203: No. 6, 1408-10(1972). (In Russian).

Beans (Vicia faba) were germinated in sand until rootlets 4 cm long had developed, and then gamma-irradiated with 200 R from a ^{137}Cs source. Frozen root sections (liquid N_2) were ground to a powder and extracted with 75% ethanol. Extracts were subjected to cytogenetic activity tests and to paper electrophoresis. Disturbance of the natural mutagenic-antomutagenic system by irradiation of meristem cells is discussed. (KSW)

Radiation Effects on Animals

Refer also to abstracts 17223, 17224, and 17593.

17570 (AEC-tr-7397, pp 1-14) THIOL CONCEPT OF RADIOSENSITIVITY. Graevskii, E. Ya.; Tarasenko, A. G. (Inst. of the Biology of Development, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 483-492(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The role of thiols in determining radiosensitivity is discussed, taking into account the fundamental principles of the concept, which can be summarized as follows: the radiosensitivity of biological objects exhibits a direct dependence on their content of thiols; this dependence is expressed more strongly the lesser the compared objects differ from one another in all other respects; artificial modification of radiosensitivity by means of radioprotective and radiosensitizing drugs is a result of change in the content of thiols. On the basis of a generalization of the authors' own data and data in the literature, obtained using the most different biological objects, the paper gives proof of the presented concept. (tr-auth)

17571 THEORY OF DUAL RADIATION ACTION. Kellerer, A. M.; Rossi, H. D. (Columbia Univ., New York). Contract AT(11-1)-3243. Curr. Top. Radiat. Res. Quart.; 8: No. 2, 85-158(Oct 1972).

The theory of dual radiation action arose from the finding that for a wide range of effects on higher organisms the RBE (relative biological effectiveness) of various ionizing radiations exhibits a simple and consistent dependence on absorbed dose. It is postulated that the common fundamental cause of these effects is the production of elementary lesions that proceeds at a rate proportional to the square of local energy concentration within regions termed "sites." The concepts of microdosimetry permit a quantitative characterization of this process in terms of the specific energy (z), and it is deduced that the diameter of sites is comparable to the nuclear diameter (i.e. is of the order of μm). The domains of primary interaction between radiation and the biological substrate, which are termed "loci," are several orders of magnitude smaller. A dependence of effect on the square of local energy concentration has often been postulated for the production of chromosome aberrations. The theory of dual radiation action leads to a rigorous formulation of these considerations and permits the derivation of the dose-effect curves for different radiation qualities. For other cellular effects the theory accounts not for the explicit shape of the dose-effect curve but for the dose-RBE relation. While the analysis explains the general features of the RBE-LET relation, saturation corrections must be applied at high values of LET. These as well as corresponding modifications in the case of anoxia are not unambiguously established. The theory permits a systematic treatment of the effects of various temporal distributions of absorbed dose (varying dose-rate, fractionation). Departures from the theory are considered but their significance appears uncertain. (auth)

Man

Refer also to abstracts 17242, 17258, 17259, 17519, 17602, and 19343.

17572 (ABCC-71-72) ANNUAL REPORT, 1 JULY 1971-30 JUNE 1972. (Atomic Bomb Casualty Commission, Hiroshima (Japan)). [nd]. 382p. (In English and Japanese). Dep. NTIS.

Brief summaries are presented of 71 studies conducted during 1971 and 1972 on the populations of Hiroshima and Nagasaki exposed to mixed γ and neutron irradiation during the atomic bombings, and their progeny. The primary purpose of the studies was to document the late effects of radiation on man in relation to estimated doses. The contributions of fallout and exposure to x radiation during diagnostic dental and medical radiography to the total radiation dose of the population are also considered. Epidemiological studies on the population attempt to establish a relationship between the exposure dose and growth rate, aging, mortality, the incidence of leukemia and other neoplastic diseases, the general health status, and the incidence of specific diseases and disorders. A list of publications during 1971 and 1972 that report results from these studies and a chronological list of previous publications are included. (CH)

17573 (ABCC-TR-26-71) FERTILITY AMONG FEMALE SURVIVORS OF THE ATOMIC BOMBS, HIROSHIMA AND NAGASAKI. Blot, W. J.; Sawada, H. (Atomic Bomb Casualty Commission, Hiroshima (Japan)). 15 Jul 1971. 24p. (In English and Japanese). Dep. NTIS.

Results are reported from a study of the fertility of female survivors of the atomic bombs at Hiroshima and Nagasaki. The data indicate no evidence that those in the higher radiation dose groups suffered impairment of long-range fertility. (CH)

17574 (ABCC-TR-31-71) AUTOPSY STUDY OF LEUKEMIA IN ATOMIC BOMB SURVIVORS, HIROSHIMA AND NAGASAKI, 1949-69. Liu, P. I.; Ishimaru, T.; McGregor, D. H.; Yamamoto, T.; Steer, A. (Atomic Bomb Casualty Commission, Hiroshima (Japan)). 21 Oct 1971. 21p. (In English and Japanese). Dep. NTIS.

A study was made of 474 autopsies of leukemia cases at ABCC in Hiroshima and Nagasaki from 1949 to the end of 1969. These cases were examined in relation to dose of radiation at the time of bomb using tentative 1965 dose estimates. The pathologic findings were compared by dose for 361 leukemia cases born before the bomb. Pathologically, no individual autopsied leukemia case could be differentiated and designated as being radiation-induced in this study. No case of chronic lymphocytic leukemia was detected among cases receiving 1 rad or more. No statistically significant difference related to radiation dose was found in acute leukemia and chronic granulocytic leukemia for the weights of the liver, spleen, and kidneys, the intensity of leukemic cell infiltrates in various tissues, the occurrence of tuberculosis, or the occurrence of blast crisis in chronic granulocytic leukemia, except in the intensity of leukemic infiltration in the lung of chronic granulocytic leukemia patients. A longer survival time and possibly less intense leukemic infiltration in the lung of chronic granulocytic leukemia patients who received 1 rad or more were observed, but these presumably are due to some factor other than radiation, since no dose-response relationship could be confirmed. (auth)

17575 (AEC-tr-7397, pp 199-202) MEASUREMENT OF ABSORBED DOSES IN THE SKIN USING LiF-FLUOROPLAST THERMOLUMINESCENT DOSIMETERS. Dushenkov, A. S.; Kharitonov, V. G.; Shaks, A. N. (Inst. of Biophysics, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 622-625(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The development of thermoluminescent dosimeters for measuring both the total absorbed doses and dose distributions in human skin is described. The basis for the dosimeters in LiF in a mixture with type-A fluoroplast-4. The dosimeters were from 20 to 400 μ thick. Both the total absorbed doses of β- and γ radiation and the dose distribution from a thallium-204 applicator were measured. Such dosimeters can be used for measuring absorbed doses in the skin. (tr-auth)

17576 (JUL-881-ST) 1971 ANNUAL REPORT OF THE CENTRAL DIVISION OF RADIATION PROTECTION. Keller, M.; Tzschaschel, R. (eds.) (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz). Aug 1972. 155p. (In German). Dep. NTIS (U.S. Sales Only).

Service activities carried out in 1971 for operations monitoring, personnel monitoring, environmental monitoring, central service, measurements of distribution of dangerous materials in the atmosphere, and further development of radiation protection methods are described. Results of investigations and developments in connection with improvement of methods and procedures are presented. A bibliography of all the published and internal literature of the health physics division in 1971 is included. (MCG)

17577 (LFEN-131-a) PERSONNEL DOSIMETRY IN X-RAY AND RADIOISOTOPE INSTALLATIONS FOR MEDICAL USE. Vaz Carreiro, J.; Da Silva, Heitor P. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 22p. (In Portuguese). (CONF-700863-1). Dep. NTIS (U. S. Sales Only).

From 3rd congress of Luso-Brazilion radiology conference; Rio de Janeiro, Brazil (Aug 1970).

The results of personnel dosimetry in diagnostic x-ray and radioisotope installations in Portugal for the years 1968 and 1969 are reported and analyzed. The distribution of accumulated doses, the yearly mean dose per person, and the frequency of doses exceeding the maximum permissible limits are tabulated. The results were compared with those obtained from 1964 to 1967. (JSR)

17578 (NP-19638) EFFECTS ON POPULATIONS OF EXPOSURE TO LOW LEVELS OF IONIZING RADIATION. Report of the Advisory Committee on the Biological Effects of Ionizing Radiations. (National Academy of Sciences-National Research Council, Washington, D. C. Div. of Medical Sciences). Nov 1972. 217p.

Separate abstracts were prepared on five sections of this report that review data pertinent to the establishment of radiation protection standards for the human population and the re-evaluation of existing scientific knowledge concerning radiation exposure of man. A list of 440 references, in addition to those following each section, is included. (CH)

For abstracts of individual sections see: 17579 through 17583.

17579 (NP-19638, pp 11-19) SOURCES OF IONIZING RADIATION AND POPULATION EXPOSURES. Nov 1972. In Effects on Populations of Exposure to Low Levels of Ionizing Radiation.

Data on the sources of ionizing radiation to which human populations are exposed and estimates of the total average dose from each source to the population of the USA during 1970 are presented. The sources of exposure, each of which is discussed in detail, include natural background radiation; diagnostic medical uses including exposure to x radiation during dental and medical radiography and diagnostic studies using radioisotopes; the nuclear power industry, including the mining, milling, and fabrication of uranium, the operation of nuclear power reactors, the operation of nuclear fuel reprocessing plants, and the release of radioactive wastes to the environment; the operation of nuclear ships; nuclear rocket development programs; occupational radiation exposures; and miscellaneous sources such as television, air transport, and consumer products. The impact of the development of the nuclear power industry on the population exposure dose in the year 2000 is postulated. The data show that in 1970 the whole-body estimated dose rate to man from all sources was 182 mrem/yr, with diagnostic medical uses of x radiation the major contributor and natural background radiation the second largest contributor. Areas of uncertainty in assessing future radiation exposure doses for the population are discussed briefly. (CH)

17580 (NP-19638, pp 21-40) ENVIRONMENTAL TRANSPORT AND EFFECTS OF RADIONUCLIDES. Nov 1972. In Effects on Populations of Exposure to Low Levels of Ionizing Radiation.

Reasons why the situation with regard to radioactivity in the environment differs from that of pesticides and other chemical pollutants are considered. One set of reasons involves regulation and use. Release of radioactivity has always been under primarily governmental control or regulation. Possible hazards of radiation were recognized prior to environmental radiocontamination. The other set of reasons involves biological effects. Evidence indicates that probably no other living organisms are very much more radiosensitive than man, so that if man as an individual is protected, then other organisms as populations would be most unlikely to suffer harm. With the increased use of nuclear energy by man, it is considered only prudent that ecological considerations should be improved and strengthened. (213 references) (MCG)

17581 (NP-19638, pp 41-72) GENETIC EFFECTS OF IONIZING RADIATION. Nov 1972. In Effects on Populations of Exposure to Low Levels of Ionizing Radiation.

Information available in 1972 on the genetic risk to the human population from low levels of ionizing radiation is reviewed. Data from studies on experimental mammals are summarized. It was concluded that the genetically significant radiation exposure from fallout, from nuclear power developments, and from occupational exposure (treated as a part of the over-all population average) is now very small relative to that from natural radiation. The 1956 report and the guides for maximum permissible radiation dose that grew out of it were the result of an effort to balance genetic risks against the needs of society. It now appears that these needs can be met with less than the 170 mrem per year of the current Radiation Protection Guides. (94 references) (CH)

17582 (NP-19638, pp 73-82) EFFECTS OF IONIZING RADIATION ON GROWTH AND DEVELOPMENT. Nov 1972. In Effects on Populations of Exposure to Low Levels of Ionizing Radiation.

It has long been recognized that fetal and juvenile mammals are especially sensitive to harm by exposure to ionizing radiation. The mechanisms by which radiation alters the development of structure, behavior, and other functions are extremely complex. Since data on effects on humans are limited, data on experimental mammals are included, and data on humans exposed during therapy of the pregnant mother or as juveniles, data on the Hiroshima-Nagasaki survivors of the atomic bombs, and data on the population of the Marshall Islands exposed to fresh fallout in 1954 are summarized. The data indicate that, with single brief exposures, the lowest doses observed to bring about effects on growth and development at certain stages in experimental mammals range from a few rads to 50 rads. Occasional germ cells, at certain stages in early life, are killed by a few rads, with no detectable functional effects. Subtle but permanent alterations in nerve cells, at some stages, occur after 10 to 20 rads, but no alterations in behavior are recognized until about 25 rads are given at some stages in prenatal life. The threshold for morphologic alterations in man following irradiation in prenatal life is less precisely known, but observations on the Japanese exposed to atomic bomb radiation place it between 50 and 25 rads to the mother. (68 references) (CH)

17583 (NP-19638, pp 83-199) SOMATIC EFFECTS OF IONIZING RADIATION. Nov 1972. In Effects on Populations of Exposure to Low Levels of Ionizing Radiation.

All available data on the somatic effects of low-level ionizing radiation on man are reviewed. It is pointed out that, with few exceptions, somatic effects are manifest only after an interval of years or decades following irradiation and are indistinguishable from lesions that occur naturally. The relationship of somatic effects to radiation is detectable only in a statistical sense, and the smaller the radiation dose the less likelihood that radiation was a prime cause. Better knowledge of dose-response relationships and the susceptibility of the human population than is now available will be required to specify numerically the risks of radiation effects under conditions of low-level exposure. Estimates of the risks of effects at low dose levels are based on extrapolation from observations at higher dose levels and assumptions on the nature of the dose-response relationship, the mechanisms involved, the susceptibility of the population at risk, and other factors. For induction of cataract of the lens and impairment of fertility there is radiobiological and clinical evidence of a nonlinear relationship between effect and dose, these effects presumably depending in large measure on the killing of cells in the lens and gonads, respectively. These considerations imply that there is no or little risk of inducing such effects at doses and dose rates approaching natural background radiation levels. For induction of some tumors, a linear non-threshold dose-effect relationship cannot be excluded from existing data, nor can the possibility that such effects might result from sublethal injury in only one or more cells of the body. Available evidence indicates that the most important effect of radiation on the mortality of human populations results from carcinogenesis, including leukemogenesis. Problems involved in the retrospective evaluation of patients with neoplasms for a possible history of relevant radiation exposure in view of the long latent period (years or decades) between irradiation and

the appearance of a clinically detectable neoplasm, the natural incidence of cancer, and other factors, are discussed. (315 references) (CH)

17584 (NRPB-R-5) STUDY OF CHROMOSOME ABERRATION YIELD IN HUMAN LYMPHOCYTES AS AN INDICATOR OF RADIATION DOSE. II. A REVIEW OF CASES INVESTIGATED: 1970–71. Purrott, R. J.; Dolphin, G. W.; Lloyd, D. C.; Rickard, B.; Eltham, E. (National Radiological Protection Board, Harwell (England)). Oct 1972. 19p. UK 50 pence.

The results of cytogenetic investigations into forty-one cases of suspected over exposure to radiation are reviewed. Where possible, comparisons were made with conventional film badge dosimetry and accident reconstruction investigations. In many cases chromosome dosimetry gave highly comparable results, while in cases where no badges were worn or their readings were suspect then very credible dose estimates were obtained. The demonstration of undamaged chromosomes proved most reassuring in instances of zero or trivial doses. It was concluded that chromosome dosimetry is now sufficiently well developed to form a valuable and practicable technique in radiological protection. (auth)

17585 RADIATION PROCTITIS. Extirpation of the Rectum. Toupet Technique. Cabral Ayarragaray, A. M. Prensa Med. Argent.; 57: No. 13, 643-645(1970). (In Spanish).

One of the complications of radiotherapy for the treatment of gynecological cancer is radiation proctitis. The macroscopic pathological anatomy shown in the rectoscopic image of radiation proctitis is divided into five stages, ranging from bloody edematous rectitis to necrosis compromising other organs. The histology of this process includes glandular dilation, hypersecretion of the mucous, and hyperplasia processes with atypical cellular death and epithelial disappearance. The stomach undergoes edema and the muscular cover of the rectum atrophies. The arteries suffer endarteritis, thrombosis, and sclerosis. Clinically the first symptoms appear between the first and fourth month following the irradiation treatment; on occasion they appear four to six years later. In hypersensitive patients, signs of proctitis appear after receiving 800 R. The treatment is outlined. (JSR)

17586 ANGIOGRAPHIC DEMONSTRATION OF SPINAL CORD ARTERIAL OCCLUSION IN POSTRADIATION MYELOMALACIA. Di Chiro, G.; Herdt, J. R. Radiology; 106: No. 2, 317-319(Feb 1973).

A verified case of myelomalacia following radiotherapy of 6,000 rads to the cervicothoracic cord for treatment of a hemangioblastoma is reported. Selective spinal cord arteriography was carried out before and after radiotherapy. A radiculomedullary artery and the anterior spinal artery in the cervicothoracic territory were large and supplied a tumoral blush. In the postradiation arteriogram, the same vessels were occluded and the blush disappeared. This study supports the theory that postradiation neural changes are mainly secondary to vascular damage. (auth)

17587 RADIATION HEPATITIS INDUCED BY ABDOMINAL IRRADIATION WITH THE ^{60}Co MOVING STRIP TECHNIQUE. Wharton, J. T.; Delclos, L.; Gallager, S.; Smith, J. P. (Univ.) of Texas, Houston). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 117: No. 1, 73-80(Jan 1973).

Irradiation of the entire liver with doses of 2,450 to 2,920 rads γ given by the moving strip technique caused liver injury in 14 of 65 patients treated. The clinical picture of radiation hepatitis may consist of hepatomegaly, ascites, pleural effusion, and alteration in liver function. The response to the injury sustained is variable, and patients may die within a short time. The chronic form may be a continuation of the acute injury, or the patient may experience an abrupt onset of symptoms. Sinusoidal congestion, parenchymal atrophy, and subintimal fibrous thickening of the central veins are early histologic manifestations of liver injury, whereas dense fibrous occlusion of the vein lumina is a late effect. (auth)

17588 RADIATION DOSE OF THE URETER DURING THERAPY OF THE CARCINOMA OF THE UTERUS. DOSE MEASUREMENTS ACCORDING TO THE THERMOLUMINESCENCE METHOD. Gerstner, H. D. Homburg, Ger.; Univ. des Saarlandes (1971). 70p. (In German).

Thesis.

The problems of radiotherapy of the uterus carcinoma are pointed out using literature data. Especially radiogenic ureter changes are described and earlier measurements of ureter doses are presented. The radiation dose in the distal ureter during ^{226}Ra γ implant and x ray therapy was measured using TLD dosimeter. The measurements of each applicator type showed that position deviations of the Ra applicator resulted in different doses to separate ureter sections. The TLD is very expensive and not suitable as a routine method during radiotherapy of the uterus carcinoma, but in special cases its use can be helpful for the patients. (GF)

17589 PROBLEMS WITH THE IRRADIATION OF CHILDREN AND PREGNANT PATIENTS. D'Angio, G. J.; Nisce, L. Z. Amer. Med. Ass.; 223: No. 2, 171–173(8 Jan 1973).

Problems presented when a child or pregnant woman must be irradiated for therapeutic reasons are reviewed. It is pointed out that the immediate and late effects of radiation therapy are more pronounced in the young and the relative advantages and disadvantages of large-field irradiation must be carefully evaluated for these patients. For pregnant women who require irradiation of large pelvic areas, a recommendation for therapeutic abortion would seem justified. The principal considerations would be the risk of a malformed fetus consequent to radiation therapy during the first trimester and the hazards to the fetus and to its genetic materials during later stages of pregnancy. When the pelvic region must receive the full therapeutic dose or a major portion thereof, spontaneous abortion or premature birth of a stillborn fetus often occurs. Therapeutic treatment policies that are suitable for adults may not be advisable for children, since disturbances in bone growth, the induction of latent secondary neoplasms (especially in bones and thyroid), impairment of the function of irradiated glands and organs (especially the gonads), and genetic effects are all sequalae of irradiation of children at therapeutic doses. Gonadal shields offer protection to male children. Surgical repositioning of the ovaries to sites that can be shielded has been practiced for some years but the data accumulated on patients who have survived to sexual maturity is too scanty for proper evaluation. Social factors to be considered in counseling patients who have been subjected to large field radiotherapy regarding marriage and pregnancy are briefly summarized. (CH)

17590 ENVIRONMENTAL INDICES FOR RADIOACTIVITY RELEASES. Rohwer, P. S.; Struxness, E. G. (Oak Ridge National Lab., TN). pp 249–255 of Indicators of Environmental Quality. Thomas, W. A. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on Indicators of Environmental Quality; Philadelphia, Pennsylvania, United States of America (USA) (26 Dec 1971). See CONF-711222–.

The Cumulative Exposure Index (CUEX) concept was developed to facilitate realistic assessment of the radiation dose to man as a result of environmental releases of radioactivity. CUEX is defined as a numerical guide indicating the relative significance (dose estimate ÷ dose limit) of measured environmental radioactivity on the basis of the estimated total dose to man for all radionuclides and all exposure modes of importance. The aim in developing this concept is to assess the releases on the basis of time-integrated radionuclide concentrations measured in suitable environmental sampling media; typical measurements would be concentrations in air or water or on the land surface. The measured concentrations are assessed in relation to basic radiation safety standards recommended by recognized authorities for application to members of the public. Because the recommended standards are expressed in units of dose (rem), the CUEX concept, of necessity, embodies environmental models and dose models to convert the measured environmental radionuclide concentrations into estimates of radiation dose to man. The final estimate of dose, which includes a contribution for each radionuclide and exposure mode of significance, is compared with the appropriate radiation safety standard to complete the assessment. (ERB)

17591 IN VIVO THERMOLUMINESCENT DOSIMETRY ON PATIENTS TREATED WITH HIGH ENERGY ELECTRONS. Van Dam, J. (Univ., Louvain, Belgium). J. Belge Radiol.; 55: No. 2, 293-296(1972). (In Dutch).

Thermoluminescent dosimetry was used as a daily check of the reproductibility of the ratio of the dose delivered to the dose asked by the doctor for patients irradiated with electrons of high energy. A special study was devoted to cases where the curvature of the skin surface rendered difficult a correct and reproducible set-up of the patient. From one session to another the differences between the ratios of the dose delivered to the dose asked can be of the order of 10%. (auth)

17592 PEDIATRICS, RADIOLOGY, AND IRRADIATION. Claus, D. (St. Pierre Hospital, Louvain, Belgium); Gillet, R.; Wambersie, A. J. Belge Radiol.; 55: No. 2, 263-270(1972). (In French).

The protection in radiological pediatrics sets a particular problem as the child is specially sensitive to x rays and often unnecessarily overexposed. A tentative approach to the dose received by the child during radiological tests is made as well

as to the manner in which the irradiation varies according to the utilized technique. (auth)

17593 NEW TRENDS IN RADIATION PROTECTION. Sixth International Congress Held at Bordeaux, France, March 27, 1972. Montrouge, France; Societe Francaise de Radioprotection (1972). 1138p. (In French and English). (CONF-720328).

Separate abstracts were prepared for each of the 60 papers presented. (France)

For abstracts of individual papers see: 17017, 17018, 17149, 17157, 17223–17225, 17239–17241, 17248, 17249, 17263, 17270, 17271, 17293, 17299, 17321–17325, 17397–17404, 17420, 17421, 17477, 17507, 17508, 17594–17605, 17666, 17688, 17699–17702, 17946, 17960, 17961, 19242, 19290, 19344, and 19345.

17594 REM-MAN. Delpla, M.; Vignes, S. (Electricite de France, Paris). pp 19-43 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The theoretical collective damage experienced by an entire population is defined. This damage is directly connected to the irradiation of the population viz the product of the number of individuals in the population and the mean dose expressed in rem–men. The results of irradiation are discussed for three nuclear reactor plants: Chinon 2 (during 3 yrs), CNA (during 3 yrs, extensive repairs being carried out during a period of more than one year) and SLE1 (extensive repairs being carried out during a period of more than one year). (France)

17595 EXPERIENCE GAINED FROM ANOMALIES AND INCIDENTS THAT HAVE OCCURRED WITH X-RAY GENERATORS USED FOR SCIENTIFIC PURPOSES. Choquet, R. (Paris Univ., Orsay, France); Maczynski, A.; Renard, C. pp 45-66 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

X ray sources used in crystallography, x-ray fluorescence measurements, and industrial radiology are considered. Eighty-two x-ray generating units in the Paris area were examined. The investigations carried out indicated that irradiation accidents resulted most frequently because operating personnel were unaware of the biological risks associated with ionizing radiations and the techniques that should be employed when working with such sources. Statistical analysis indicates that personnel dosimeters frequently fail to give the exact doses received by individuals exposed to the direct beam and can give the experimenter a false sense of security. The anomalies and incidents that have occurred are listed, advice in order to prevent future accidents being given. (France)

17596 METHODS AND RESULTS: JOINT RADIATION SURVEY, PUERTO RICO, 1968. Gileadi, Michael; Gileadi, A. E. (Puerto Rico Nuclear Center, Mayaguez). pp 621-38 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The primary objective of the survey was to evaluate the potential health hazards and genetic effects associated with a certain group of abdominal x-ray examinations carefully selected in such a way that approximately 90% of the genetically significant dose is due to x-ray diagnostic examinations within this group. Quantifiers used to describe the hazards both in magnitude as well as in frequency of occurrence include: per capita per annum gonadal dose; mean gonadal dose per procedure; and genetically significant dose. Genetically significant doses were computed by means of the GSDPR-code, based upon the Penfil–Brown formula and operative on the IBM 360/40 computer. The survey includes a complete statistical study of the x-ray diagnostic procedures performed during 1968 in Puerto Rico, as well as a rather extensive dosimetric study to determine the average gonadal dose associated with each diagnostic procedure considered. Instrumentation includes Victoreen ion chambers, TLD–LiF powder dosimeters, and high sensitivity Dupont SX-249-126 film packages. Several different x-ray units—typically used in Puerto Rico—served as irradiation sources. A Rando-phantom was used in the majority of dose-measurements always carefully and closely simulating all circumstances of the x-ray diagnostic procedure under consideration. In vivo dose measurements corroborate results obtained with a Rando-phantom. Relevant results are presented. Future plans include design and implementation of a computerized system, which based upon results of the present survey, specifically upon the mean gonadal doses associated with each x-ray diagnostic procedure, will establish and store an updated retrievable record of cumulative irradiation doses received by the individual during such procedures. (France)

17597 PROGRESS IN HOSPITAL HEALTH PHYSICS: 12 YEARS WORK IN THE RADIOLOGY DEPARTMENT OF A CANCER RESEARCH CENTER. Milhaud, F.; Obry, J. M.; Delouche, G.; (and others) (Centre de Lutte Contre le Cancer Rene Huguenin, Saint-Cloud, France). pp 639-53 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The use of different radiation sources in a radiology department leads to various health physics problems. These problems relate to use of radioisotopes for diagnosis, high energy radiotherapy, curietherapy, and diagnostic radiography. The dosimeter films used to monitor department personnel are examined as a function of the appropriate technical parameters; protective measures are taken to reduce the dose received. (France)

17598 HEALTH PHYSICS PROBLEMS IN THE DEVELOPMENT OF THE RADIATION PROTECTION SERVICE AT CERN. Baarli, J.; Hoefert, M. (European Organization for Nuclear Research, Geneva). pp 677-702 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The European Organization for Nuclear Research, CERN, which is located partly in France and partly in Switzerland, operates three large particle accelerators that were built by the Organization (a 600 MeV synchro-cyclotron, a 28 GeV Proton Synchrotron, and a 28 GeV Intersecting Storage Ring). At the present time, these accelerators are in use for fundamental nuclear physics research. In the development and use of these accelerators a number of health physics problems have been investigated and adapted to the particular need of the Laboratory. It is shown that these range from radiation dosimetry to practical radiation protection problems specific to accelerators and also include aspects related to the location and international character of the Laboratory. Emphasis is given to the methods adopted. (France)

17599 PROGRESS IN THE METHODS AND ORGANIZATION OF THE RADIOLOGICAL PROTECTION OF PERSONNEL WORKING WITH RADIATIONS IN THE INDUSTRIAL COMPLEXES OF THE MARCOULE CENTER. Chassany, J.; Peyresblanques, H. (Centre de Marcoule, Bagnols-sur-Ceze, France). pp 703-18 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Radioprotection techniques at the Marcoule Center have undergone considerable development since the center began operating in 1956. These techniques were adapted to the well defined safety measures and production factors required at different periods. A planned and supervised administrative policy is necessary if new economic requirements are to be met and the present safety standards retained. (France)

17600 PROTECTION OF PERSONNEL IN CONVENTIONAL AND NUCLEAR EDF POWER STATIONS. Feron, J. (Electricite de France, Saint-Denis). pp 719-52 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

An analysis is made of the accident risks to which personnel working in conventional thermal power stations, and nuclear power stations are exposed. Such risks are very varied as many different tasks are performed. It is shown that certain preventative methods used in conventional EDF power stations are equally applicable to nuclear power stations. The existing organization and procedures are presented. The results acquired over a 10-yr period are given. (France)

17601 HEALTH PHYSICS CONTROL IN A NUCLEAR POWER STATION. Dode, J.; Martin, J. J. (Electricite de France, Saint-Laurent-des-Eaux). pp 777-95 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The radioprotection techniques developed after operating graphite-gas reactors over a period of several years are discussed. The controls envisaged necessary for light water reac-

tors are based on the experience acquired in operating the nuclear power plant in the Ardennes. Measurements made at fixed points can not determine the degree to which personnel are exposed; environmental monitoring equipment serves uniquely to give the alarm when personnel should be evacuated. The risk of highly localized accidental exposure of personnel principally concerns external irradiation. Very reliable equipment fixed or mobile, according to the nature of the work undertaken, must be employed. The analysis of permanent risks such as external irradiation observed under normal operating conditions or atmospheric contamination demonstrates that such hazards are unlikely to occur without some prior warning signs, e.g., variations in the activity of the primary circuit or the gaseous effluent. Accidental irradiations are only likely to arise during emergencies in which temporary measurements, control procedures, instructions, and shielding are employed. The prevention of the release of high levels of radioactive effluent depends on the checking of the integrity of the filters through which the gaseous effluent released pass and the isolation of the primary and secondary fluid circuits. The normal effluent release is supervised and its effect on the absorbed dose by the population evaluated; generally, environmental monitoring is insufficient for this purpose. The monitoring equipment must be permanently operated in order to provide the necessary information in the case of the maximum credible accident. (France)

17602 EFFLUENTS RELEASED FROM NUCLEAR POWER PLANTS AND ENVIRONMENTAL MONITORING. Martin, J. J.; Beau, P. (Electricite de France, Paris). pp 871-86 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From sixth international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Considerable experience has been acquired by the EDF in the field of nuclear power plants during the past 9 years. The activity of the effluents discharged is monitored at their source and in the environment. Nuclear power plants possess relatively few sources of radioactive effluent and therefore present few problems in the field of monitoring. A permanent record of the substances contaminating the primary fluid enables the potential risks of installations to be estimated. The measured activity of the effluents enables the contamination of the environment and the doses received by the population to be estimated. In contrast, measurements made under normal circumstances in the environment do not reveal this contamination to a sufficient degree of accuracy, nor do they estimate the doses received by the population with any precision. The operation of French nuclear power plants corresponds to an equivalent dose of a few millirems per year. (France)

17603 FRENCH HEALTH PHYSICS REGULATIONS AND THEIR APPLICATIONS. Chanteur, J.; Moroni, J. P. (Service Central de Protection contre les Rayonnements Ionisants, Le Vesinet, France). pp 977-89 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

A summary of the French regulations concerning health physics is presented. Various factors have influenced the development of the French health physics program, among them economic considerations and equipment requirements. The Central Service for the Protection against Ionizing Radiations is the principal statutory body concerned with the problem, its tasks including, monitoring and providing assistance in problems concerning the confrontation of organizations concerned with prevention and organizations concerned with promotion. (France)

17604 ACTIVITIES OF THE NATIONAL CENTRE FOR RADIATION PROTECTION OF THE GDR. Scheel, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin). pp 991-1000 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The activities of the National Center for Radiological Protection of the GDR are presented. These activities include legislation in the field of radioprotection, the handling of sources of ionizing radiation, and the operation of radiation facilities and nuclear installations. The following topics are discussed: the supervision on a national scale of health physics problems concerning man and the environment, the training of health physics personnel, and the research undertaken to improve radioprotection techniques. (France)

17605 HEALTH PHYSICS TRAINING AT THE CEA. Bocquet, H. (CEN, Fontenay-aux-Roses, France); Resnier, J. C. pp 1017-28 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Specialized training in health physics and the problems involved in informing personnel form part of the work undertaken by the Radioprotection department of the CEA. The purpose of this department is to establish the measures to be taken in the field of prevention and protection against ionizing radiations and to coordinate and implement the principles defined. The various training given covers specialist courses in health physics and monitoring; personnel working in radioactive environments, the duties in the field of radioprotection, safety, and health assigned to the various ministerial departments. The policy of training specialists in monitoring or as operational specialists began at the INSTN in 1961. External applicants are admitted and they represent 10% of the courses; in November 1971, specialist training courses had led to 250 qualified senior technicians, 400 senior graduate technicians, and 900 graduate decontamination staff. (France)

17606 SIMPLE AND SAFE RADIONUCLIDE INJECTION TECHNIQUE. Bolich, P. Radiology; 106: No. 2, 456-457 (Feb 1973).

The radiation exposure received by the technician while injecting a radioactive isotope can be reduced by a factor of 1,000 by using a "butterfly" needle attached to a syringe which is left inside a lead shield during injection. The large hand dose obtained while handling syringes is no longer justified. (auth)

17607 EFFECT OF ^{60}CO IRRADIATION UPON CELL-MEDIATED IMMUNITY. Gross, L.; Manfredi, O. L.; Protos, A. A. (St. Vincent's Medical Center of Richmond, Staten Island, NY). Radiology; 106: No. 3, 653-655(Mar 1973).

In a study of 45 humans, the effects of cancericidal ^{60}Co radiation on cell-mediated immunity were estimated in vivo by determination of delayed hypersensitivity response (DHR) to a nonspecific challenge system — dinitrochlorbenzene. Therapeutic doses of ^{60}Co did not adversely affect the immune responses in 85% of the patients studied, as measured by this method. The method is considered superior to the previously described in vitro procedures that lead to ambiguous conclusions. Further deterioration of DHR in the remaining 15% of patients is attributed to natural biological tumor burden rather than to radiation effect. (auth)

17608 MENTAL RETARDATION FOLLOWING IN UTERO EXPOSURE TO THE ATOMIC BOMBS OF HIROSHIMA AND NAGASAKI. Blot, W. J.; Miller, R. W. (National Cancer Inst., Bethesda, MD). Radiology; 106: No. 3, 617-619(Mar 1973).

The prevalence of mental retardation in children tested at 17 yrs of age who were exposed in utero to the atomic bombs of Hiroshima and Nagasaki was studied in relation to the most recent estimate of radiation dose received. Significant increases at doses greater than 50 rads in Hiroshima and 200 in Nagasaki were found, with the risk of mental retardation generally rising directly with increasing dose. The lower dose-effect in Hiroshima may have been due to irradiation by neutrons which were virtually absent in Nagasaki. (auth)

17609 RADIATION EXPOSURE TO PERSONNEL DURING CARDIAC CATHETERIZATION. Ardran, G. M.; Fursdon, P. S. (Oxford Univ.). Radiology; 106: No. 3, 517-518(Mar 1973).

Radiation exposure to the principal personnel carrying out a complete cardiac catheterization and ciné procedure was measured in 18 examinations. Film badges were worn in the collar, under and over the protective apron, and on the dominant wrist. The average exposure to the trunk area under the apron was about 2 mR. If correct protection precautions are taken, cardiac procedures would not appear to be unduly hazardous. (auth)

17610 POSSIBLE RELATIONSHIP BETWEEN SMALL DOSE IRRADIATION TO THE SCALP AND INTRACRANIAL MENINGIOMAS. Beller, A. J.; Feinsod, M.; Sahar, A. (Hebrew Univ., Jerusalem). Neurochirurgia; 15: No. 4, 135-43(1972).

Data on 16 patients with intracranial meningiomas who had previously received irradiation to the scalp are reported. The interval between the irradiation and the diagnosis was between 22 to 45 years. The cases are briefly presented and the etiological association is discussed. (GF)

17611 EVALUATION CRITERIA OF IRRADIATION TECHNIQUE IN GAMMA-THERAPY. Galina, L. S. Med. Radiol.; 17: No. 7, 60-4(Jul 1972). (In Russian).

A method of integral dose calculation described previously was employed to determine the integral γ dose within the focus volume. Criteria for evaluating the irradiation technique for therapy are defined including the efficiency coefficient; the mean

focal dose; and the degree of dose homogeneity within the focus volume. Examples of calculating these values for static one-field, multifield, and rotation irradiation are given. (auth)

17612 INFLUENCE OF IRRADIATION CONDITIONS ON DOSE CHARACTERISTICS IN THE PERIPHERY OF THE BODY. Vainberg, M. Sh.; Korf, N. N. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 17: No. 7, 56-60(Jul 1972). (In Russian).

The depth distribution of the absorbed therapeutic ^{60}Co γ dose in the periphery of the irradiated body when employing protective screens made of lead, copper, and plexiglass and with different distances from the protective screen to the irradiated surface was investigated. The scintillation phantom-dosimeter used for this purpose is described. The results of measurements are presented as a ratio of the energy absorbed by the sensitive layer of the skin to the conditions of irradiation. (auth)

17613 COMBINED TREATMENT OF MALIGNANT TUMOR WITH IRRADIATION AND BLEOMYCIN. Yamashita, Hisao (Keio Univ., Tokyo); Nagase, Tetsuya; Kamata, Rikisaburo; Nakajo, Hideo; Gomi, Makoto. Nippon Gan Chiryo Gakkai-Shi; 7: No. 1, 1-15(Apr 1972). (In Japanese).

Gamma rays from a ^{60}Co source and x rays from a 4.3- or 6-MeV linear accelerator were administered in doses of 5,000 to 7,000 rads. In some cases electron beams from a betatron were administered in doses of 5,000 to 10,000 rads. Total doses of 150 to 500 mg of bleomycin were given before, after, or during irradiation. The total number of patients was 79. The following types of carcinomas were treated: esophagus, 24 cases; tongue, 11 cases; maxillary sinus, 10 cases; pharynx and larynx, 10 cases; lungs, 7 cases; and 17 others. Side effects included fever, dermatitis, pneumonitis, fibrosis of lungs, and stomatitis. Complete disappearance of the tumor occurred in 42 cases, effective results in 27 cases, and non-effective results in 10 cases. The 1 yr survival rate was 73% and the 1.5 yr survival rate was 56%. If precautions were taken against pulmonary side effects, the most desirable results could be attained when the total dose of bleomycin was limited to 150 mg and the total radiation dose was 5,000 to 7,000 rads over a period of 5 to 6 weeks. (HLW)

17614 REMARKS CONCERNING THE MEASUREMENT TECHNIQUE AND RADIATION EXPOSURE OF THE POPULATION BASED ON LARGE-SURFACE DIAGNOSTIC FILM DOSIMETER AND EVALUATION OF THE EXPERIMENTAL DATA. Bogdany, Barna; Bojtor, Ivan Magy. Radiol.; 24: No. 5, 271-276(Oct 1972). (In Hungarian).

A series of measurements was initiated in 1966 to obtain a large volume of data for the purpose of deriving information on x radiation exposure of various population groups caused by a routine chest radiographic examination during population screening surveys. The PTW diamentor instrument and the large-surface film technique were used for the study. On the basis of the sensitivity of the film, its facing, and evaluation of the conditions of exposure it was concluded that the technique may be used to determine the population burden from the information collected during population screening surveys. The results revealed that the radiation exposures of the population were too high and it is suggested that special screens be used in order to reduce the radiation exposure dose. (TTT)

17615 DETERMINATION OF THE RADIATION BURDEN OF MEDICAL ORIGIN OF THE POPULATION. Vittay, Pal Magy. Radiol.; 24: No. 5, 264-265(Oct 1972). (In Hungarian).

In view of the free medical service available in socialist countries there is a considerable risk of exposing the general population to unnecessarily high radiation levels resulting from diagnostic procedures, especially radiography. A project was initiated to determine as precisely as possible the level of exposure due to diagnostic medical procedures in Hungary. The physical data were collected on selected individuals, making it possible to draw general conclusions for the population at large. In devising the dosimetric technique for collecting the data, care was taken to avoid undue interference with the work routine and to avoid inconvenience to the patients, while recording all parameters needed for evaluation. An instrument was developed making it possible to determine the radiation energy absorbed in the body; the data were collected in machine-readable form. In order to derive gonad or bone-marrow doses, correction factors obtained from measurements with phantoms were used. The data will be used to devise improved methods to reduce the body burden. (TTT)

17616 METHODS FOR MEASURING THE RADIATION EXPOSURE OF THE POPULATION DUE TO RADIOLOGICAL DIAGNOSTICS. Bojtor, Ivan Magy. Radiol.; 24: No. 5, 266-271(Oct 1972). (In Hungarian).

Measurement of the surface dose ($R \cdot cm^2$), proposed by E. Zieler, was selected as the chief criterion to determine the radiation burden of the population. The genetically significant dose is not suited to express the biological effect of radiation but can be used to compare the genetic effects of various radiation sources. The importance of the significant leukemic dose, integral dose, and incident surface dose is compared. It was concluded that data obtained with individual persons may be used to calculate the overall radiation burden of the population, if radiation fields at the body, the level of irradiation, the incident surface dose, transformation factors concerning the depth dose, distribution of critical organs within the body, and statistical data on the country-wide use of x-ray diagnostic work are known. (TTT)

17617 THREE CASES OF RADIATION MYELOPATHY. Suzuki, N.; Yoshizawa, H.; Morikawa, Y.; Tanaka, Y. (Keio Univ., Tokyo). 7: No. 5, 359-367(May 1972). (In Japanese).

Case 1 was a 68-year-old male who received Linac x-ray irradiation for lung cancer and the spinal cord, T_{5-8}, was exposed to 10,000 rads. From 18 months after irradiation, he had sensory abnormality in the lower limbs and showed lower muscular strength and difficulty of walking. With complete transversal lesion of the spinal cord lower from the 7th thoracic cord region, he died 8 months after appearance of these symptoms. In autopsy, deformation of the 7th to higher regions and of the right lateral cord were seen, with occurrence of hemorrhage and coagulative necrosis observed by microscopy. The vascular wall was dilated, with highly degenerated destruction of medullated nerve fibers and decrease of nerve cells. Case 2 was a 35-year-old male who received deep x-ray, Linac x-ray, and ^{60}Co γ-ray irradiation after surgery for nasopharyngeal carcinoma with lymph node metastases. Cervical cord (1−6) was exposed to 12,000 rads. Desquamation surgery was carried out for doubtful adhesive spinal meningitis and radiation myelopathy. Arachnoid and spinal cord were adhered, centered around the 4th cervical cord, with C_5 cord turned yellow and C_4 cord violet. Case 3 was a 65-year-old female receiving ^{60}Co γ-ray irradiation after drastic surgery for left mammary cancer. Thoracic cord, T_2 to T_7 was exposed to ca. 4,500 rads. From 26 months after irradiation, difficulty in walking with cystic and rectal dysfunctions became apparent. Paralysis due to cervical osteoarthritis was suspected and laminectomy of the 6th cervical vertebra was carried out. The symptoms became worse after the operation. She was diagnosed as having radiation myelopathy, and died 18 months after appearance of these symptoms. (Japan)

17618 BIOLOGICAL DOSEMETERS. Investigation about the Reticulocytes and the Heinz bodies. Carpaij, W. J. M. (Reactor Centrum Nederland, Petten). J. Belge Radiol.; 55: No. 4, 467-480(1972). (In Dutch).

After a description of the concept of a biological dosimeter, the requirements to be fulfilled by these indicators are given. In the medical controls at the RCN much importance is given to alterations of the red blood cells more specially to the reticulocytes and the inclusion bodies (Heinz bodies). It is shown that the number of reticulocytes increases in radiological workers in proportion with the received dose. The same can be said about the Heinz bodies. (auth)

17619 BIOCHEMICAL INDICATORS OF RADIATION DAMAGE. Perspective and review. Gerber, G. B. (Commission of the European Communities, Brussels). J. Belge Radiol.; 55: No. 4, 493-501(1972).

Biochemical indicators represent an attempt to assess radiation damage on the basis of metabolic changes in the irradiated organism. While biochemical reactions are less sensitive and less specific for the radiation insult than hematological and cytogenetic ones, they have the advantage to respond early and in most cases, to be easily performed. Nevertheless, biochemical indicators have lagged somewhat in their development since due to differences between species no such test can be of use unless tested in man. The following potential indicators are discussed in more detail: excretion of deoxycytidine, of pseudouridine, of taurine, of creatine, of amino acids, and of hydroxyindolacetic acid, as well as concentration in the serum of proteins and enzymes. (auth)

17620 CHROMOSOMAL DOSEMETER, ITS INTEREST FOR THE ESTIMATION OF IRRADIATION DOSES RECEIVED BY MAN. le Go, R. (CEN, Fontenay-aux-Roses, France). J. Belge Radiol.; 55: No. 4, 481-491(1972). (In French).

The quantitative estimation of an acute human irradiation, written in terms of "single homogeneous total dose," is possible on the basis of a chromosomal analysis. The score is based on counting the dicentrics, the rings, and fragments in a lymphocyte culture of 48 hrs. The reference curves must be established by the same laboratory and with the same techniques as for the dosimetric estimation. The curves refer to a definite type of radiation (pure gamma, gamma + neutron) and to a definite energy spectrum. In these conditions, the dosimetric values obtained are reliable and their sensitivity extends to about 10 rems. (auth)

Vertebrates

17621 (AEC-tr-7397) RADIOBIOLOGY, VOL. 12, NO. 4, 1972. Translation of Radiobiologiya; 12: No. 4, 483-632(1972). 206p. Dep. NTIS.

Separate abstracts were prepared for 27 of the 28 papers in this cover-to-cover translation. The other paper discussed changes in the redox potential in muscle tissues of man and mice after administration of cystamine and cysteamine. (ERB)

For abstracts of individual papers see: 17509, 17510, 17527, 17528, 17534, 17548–17552, 17570, 17575, 17622–17634, 17690, and 17691.

17622 (AEC-tr-7397, pp 15-21) ANALYSIS OF IRRADIATED DNA BY THE METHOD OF PURINE OLIGONUCLEOTIDE MAPS. Kritskii, G. A.; Abidov, A. A.; Aleksandrov, S. V.; Batishchev, A. I.; Surina, T. Ya.; Ermakov, N. V. (Bakh Inst. of Biochemistry, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 493-497(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

A method was developed for separating purine nucleotide clusters in DNA using paper chromatography. With use of a mixture of n-butanol, 95% ethanol, and 1 M acetate-ammonia buffer with pH = 3.7 to 3.8 (6 : 5 : 3) as a solvent, DNA purine clusters are separated into eight fractions (spots). The adenine : guanine ratios were determined. It was demonstrated that immediately after local irradiation of a rabbit in a dose of 2,000 R a statistically reliable relative decrease in the larger DNA purine clusters in the bone marrow and accordingly an accumulation of smaller purine clusters can be observed. The same type of change in purine clusters is detected when DNA solutions are irradiated. (tr-auth)

17623 (AEC-tr-7397, pp 22-28) POST-RADIATION RESTORATION OF SINGLE- AND DOUBLE-STRAND BREAKS IN EU- AND HETEROCHROMATIN DNA IN THE THYMUS AND LIVER OF γ-IRRADIATED RATS. Strazhevskaya, N. B.; Struchkov, V. A. (Inst. of Biological Physics, Pushchino, USSR). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 498-502(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The viscosimetric method was used in studying single- and double-strand breaks in eu- and heterochromatin DNA in the thymus and liver of rats irradiated in a dose of 1 KR. Breaks in heterochromatin DNA arising immediately after irradiation of the rats were repaired in the liver 6 hrs after irradiation, whereas in the thymus no repair effect was observed. Immediately after irradiation it was impossible to detect breaks in euchromatin DNA in either the thymus or in the liver. It is postulated that residual nonhistone proteins in DNA fractions participate in the repair of damage. (tr-auth)

17624 (AEC-tr-7397, pp 29-33) EFFECT OF GENERAL X IRRADIATION ON THE TEMPLATE ACTIVITY OF DNA AND DNP IN THE REGENERATING LIVER OF RATS IN A RNA-POLYMERASE SYSTEM. Komar, V. E.; Nikitina, Z. S.; Shutko, A. N. (Central Scientific Research Roentgenological-Radiological Inst., Leningrad). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 503-506(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The capacity of DNA and DNP from the regenerating liver of a rat to serve as the template of DNA-dependent synthesis of RNA in a RNA-polymerase system was studied. The activity of RNA-polymerase increased considerably by 12 hrs regeneration time and decreased by 24 hrs. The total irradiation of animals in a dose of 1,500 R 3 and 6 hrs after a partial hepatectomy led to a marked inhibition of DNA template activity and virtually did not lessen the capacity of DNP to stimulate DNA-dependent RNA synthesis. (tr-auth)

17625 (AEC-tr-7397, pp 34-40) CONTENT OF NITROGENOUS METABOLITES IN PARTS OF THE BRAIN IN GUINEA PIGS DURING RADIATION DAMAGE. Agafonova, I. M.; Belikov, A. A.; Kukovinets, G. G. (Voroshilovgrad Teacher's Inst., Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 507-510 (1972).

In Radiobiology, Vol. 12, No. 4, 1972.

In three parts of the brain (large hemispheres, medulla oblongata, and midbrain (together), and in the cerebellum) of guinea pigs, the content of nitrogenous components was determined at different times after total irradiation. Considerable changes were noted in the content of urea, amino acids, and nitrogen-amide groups of proteins in the brain of these animals after irradiation in doses of 650 and 800 R. (tr-auth)

17626 (AEC-tr-7397, pp 41-47) ACTIVITY OF NATURAL INHIBITORS OF DEOXYRIBONUCLEASE I ISOLATED FROM THE SPLEEN AND ERYTHROCYTES DURING ACUTE RADIATION SICKNESS. Chebotarev, E. E.; Kerova, N. I.; Pukhova, G. G. (Zabolotny Inst. of Microbiology and Virology, Kiev). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 511-515(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

Changes in the activity of splenic and erythrocytic inhibitors of deoxyribonuclease I in white rats at early times during radiation sickness (dose 750 R) were studied. A high radiosensitivity of both investigated inhibitors was demonstrated. Some conclusions were drawn concerning the possible nature of the inhibitor of erythrocytic lysates. (tr-auth)

17627 (AEC-tr-7397, pp 48-57) ELECTROPHORETIC STUDY OF THE SPECTRUM OF PROTEINS, ANTIGENS, AND SOME ENZYMES IN THE SPLEEN AND LYMPH NODES OF RATS IN THE DYNAMICS OF ACUTE RADIATION DAMAGE. Polushkina, E. F.; Surinov, B. P.; Kashkin, K. P. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 516-523(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

Electrophoresis in agar gel was used in studying the spectrum of proteins, antigens, and nonspecific exterases in the spleen and lymph nodes and also the total activity of alkaline and acid phosphatases of extracts of these organs after a single total irradiation of the animals in a dose of 700 R. There was an impoverishment of the spectrum of proteins and antigens in the lymph nodes and spleen after irradiation, a decrease in the total activity of nonspecific esterases in the lymph nodes and an increase in the total activity of esterases in the spleen, a redistribution of the content of individual isoforms of esterases in the extracts of these organs, and an increase in the activity of alkaline and acid phosphatase in the lymph nodes and spleen of the irradiated rats. (tr-auth)

17628 (AEC-tr-7397, pp 74-81) FACTORS AFFECTING INACTIVATION OF LYMPHOCYTES OF NONSYNGENEIC STEM CELLS IN THE IRRADIATED ORGANISM. Seslavina, L. S.; Khaitov, R. M. (Inst. of Biophysics, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 535-540(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The objective of this study was to determine factors exerting an influence on inactivation of nonsyngeneic stem cells in the organism of lethally irradiated mice when they are transplanted with mixtures of lymphoid and hemopoietic tissues. It was found that the effect of inactivation of stem cells is dependent not only on the quantitative ratio of killer cells (lymphocytes) and target cells (hemopoietic stem elements), but also on the absolute number of cells entering into the interaction. The result of interaction of lymphocytes and stem cells is influenced to a considerable extent by the specific sensitizing of the donors of lymphocytes; the sex of the cell donors is also important. (tr-auth)

17629 (AEC-tr-7397, pp 93-99) INTENSIFYING THE BIOLOGICAL EFFECT OF IONIZING RADIATIONS. Communication 6. Effect of Single General Irradiation on the Course of Spontaneous Mammary Gland Cancer in Mice. Rampan, Yu. I.; Berezhnova, L. I.; Yarmonenko, S. P. (Inst. of Experimental and Clinical Oncology, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 549-553(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

In experiments on 350 common white mice with spontaneous mammary gland cancer, the authors demonstrated reliable inhibition of the growth of tumors and an increase in the lifespan of the animals after single general irradiation in a dose of 100 rad. The therapeutic effect was reduced in the case of single irradiation in doses of 25 and 200 rad, and also with an increase in the size of the tumors. Shielding of tumors did not lessen inhibition of their growth during general irradiation; this effect is evidently not caused by a direct action on the tumor cells, but indirectly, through the animal's body. (tr-auth)

17630 (AEC-tr-7397, pp 141-145) PATHOGENESIS OF POST-RADIATION HYPERGLYCEMIA AND THE PRINCIPLE FOR ITS REGULATION. Barkalaya, A. I. (Inst. of Biophysics, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 583-586(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The endocrinal elements of pathogenesis of post-radiation hyperglycemia were studied by means of a comparison of the dynamic level of corticism with glycemic shifts in adrenalectomized and intact rats and in animals injected with insulin during irradiation in a dose of 750 R. On the basis of an analysis of the author's own data and information in the literature, it is postulated that during the period of acute radiation sickness hyperglycemia develops as a result of intensified gluconeogenesis and a relative inadequacy of insulin secretion in connection with glucocorticoid aggression. This hyperglycemia is easily regulated by the rational administration of insulin. (tr-auth)

17631 (AEC-tr-7397, pp 154-157) EFFECT OF IRRADIATION ON THE FORMATION OF COMPLEXES BETWEEN RNA AND NUCLEAR PROTEINS. Likhoded, V. S.; Paskevich, I. F. (Kharkov Scientific Research Inst. of Medical Radiology). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 592-595(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The effect of irradiation on the formation of complexes between RNA, lysin histones, and acidic proteins in the nuclei of rat livers was studied. The histones from irradiated organs more actively form complexes with RNA molecules than in the control, whereas this index changes insignificantly for acidic proteins. (tr-auth)

17632 (AEC-tr-7397, pp 158-163) EFFECT OF DIGESTIVE JUICES OF THE LIVER AND PANCREAS ON RADIATION DAMAGE TO THE INTESTINE AND BONE MARROW. Fedorovskii, L. L. (Inst. of Biophysics, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 596-599(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

With preliminary draining of the digestive juices of rats irradiated in doses of 700 and 1,200 R. radiation damage to the intestine is lessened. With irradiation of animals to a dose of 700 R, draining of the bile favors not only a lessening of damage to the intestine, but also a more intensive recovery of bone marrow at early times after irradiation. In the case of irradiation of rats to a dose of 1,200 R, draining of the bile does not exert a significant influence on the number of bone marrow cells. (tr-auth)

17633 (AEC-tr-7397, pp 170-175) DEPENDENCE OF RATE OF POST-RADIATION RECOVERY ON DOSE MAGNITUDE AND INTENSITY. Akoev, I. G.; Tyazhelova, V. G.; Savel'ev, A. P. (Inst. of Biological Physics, Pushchino, USSR). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 603-607(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

On the basis of analysis of experimental data obtained using mice, rats, and dogs, a single formula is proposed for describing the dependence of the period of postradiation half-recovery on the dose intensity and irradiation dose for different species of mammals; the formula takes into account the variable value of species differences in radiosensitivity. (tr-auth)

17634 (AEC-tr-7397, pp 179-184) EFFECT OF X RADIATION ON THE DEVELOPMENT OF HYPERPOLARIZATION OF INDIVIDUAL MUSCLE FIBERS. Frol'kis, V. V.; Korotonozhkin, V. G. (Inst. of Gerontology, Kiev). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 609-613(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The intracellular microelectrode method was used in studying the effect of x radiation on the level of membrane polarization in individual muscle fibers. X irradiation in doses of 376 to 752 rad in itself did not change the membrane potential of muscle fibers, but prevented the development of hyperpolarization of cell membranes caused by different factors (injection of insulin, denervation). The greater the irradiation dose, the sooner its influence is exerted on the development of hyperpolarization. The mechanism of the influence of irradiation on the development of hyperpolarization is exerted through shifts in the biosynthesis of protein. It is shown that x irradiation prevents the development of growth in membrane potential in lesser doses in old animals or when there is preliminary injection of ribonuclease. (tr-auth)

17635 (AEC-tr-7402) RADIOBIOLOGY, VOL. 12, NO. 3, 1972. Translation of Radiobiologiya; 12: No. 3, 323-480(1972). 240p. Dep. NTIS.

Separate abstracts were prepared for 27 of the 28 papers in this cover-to-cover translation. The other paper discusses the use of a new method of quantitative determination of sulfhydryl groups for evaluating the influence of 5-methoxytryptamine and L-cysteine on the sulfhydryl group content in the mouse spleen. (ERB)

For abstracts of individual papers see: 17511–17515, 17529, 17535–17537, 17553–17555, 17636–17649, and 17675.

17636 (AEC-tr-7402, pp 1-21) SOME RESULTS OF A STUDY OF THE RADIOSENSITIVITY OF MAMMALS. Graevskaya, B. M. (Inst. of Biological Physics, Pushchino, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 323-335(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The radiosensitivity of mammals is discussed. Materials are cited on the species and line differences in radiosensitivity; the factors causing the radiation response and death of animals are discussed. The significance of damage to the radiosensitive systems of the organism in its radiation response is discussed. The dependence of the radiosensitivity on the physiological state of the organism and on factors of the external environment is discussed. The results of investigations of the correlations between radiosensitivity and the degree of expression of various biological peculiarities of animals are discussed. In conclusion, the genotypically determined factors, on which the natural sensitivity of animals to irradiation may depend, are discussed. (tr-auth)

17637 (AEC-tr-7402, pp 41-50) CONTENT OF NUCLEIC ACIDS AND THE ACTIVITY OF DEOXYRIBONUCLEASES IN THE TISSUES OF IRRADIATED RATS AFTER THE INTRODUCTION OF HIGH-POLYMER DNA. Rysina, T. N. (Inst. of Biophysics, Moscow). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 349-355(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

Changes in the nucleic acid concentration and the activity of deoxyribonucleases in the tissues of rats after irradiation at a dose of 820 R and the use of homologous high-polymer DNA as a radioprotector were studied. It was shown that during the first three days of exposure, DNA did not influence the degree of expression of the biochemical changes induced by ionizing radiation. On the basis of the data obtained, a judgment was expressed on the presumed mechanisms of the action of exogenous DNA during irradiation. (tr-auth)

17638 (AEC-tr-7402, pp 51-55) INFLUENCE OF IRRADIATION ON THE ISOENZYME COMPOSITION OF LACTATE DEHYDROGENASE OF THE LIVER AND BLOOD SERUM OF RATS. Shamrai, E. F.; Kamenets, L. Ya. (Scientific Research Roentgenoradiological and Oncological Inst., Kiev). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 356-359(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The influence of a single total irradiation of rats with x rays in a sublethal dose (250 R) on the activity of lactate dehydrogenase (LDH) and individual isoenzymes of it in the liver and blood serum was studied. A change in the total LDH activity was noted only seven days after irradiation in the blood serum. At all periods after irradiation, a change in the ratio of the isoenzymes of LDH was observed in the blood serum on account of an increase in the activity of LDH_1, LDH_3, LDH_4, and LDH_5, and in the liver chiefly on account of an increase in the activity of LDH_1, LDH_2, and LDH_3. (tr-auth)

17639 (AEC-tr-7402, pp 56-62) FLUORESCENCE-CYTOCHEMICAL INVESTIGATION OF DNA, DNP, AND PROTEINS OF CELLS OF THE THYROID GLAND UNDER THE ACTION OF IONIZING RADIATION. Khamidov, D. Kh.; Khakimov, P. A.; Mamataliev, U.; Tuichiev, S. (Inst. of Biochemistry, Tashkent). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 360-363 (1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The influence of γ irradiation on the change in the content of DNA, deoxyribonucleoproteins (DNP), and proteins in thyroid cells of the rat thyroid gland was studied by the method of cytofluorimetry. It was shown that small doses of irradiation stimulate the functional activity of the rat thyroid gland. A dynamic investigation of radiation changes in DNA, DNP, and proteins shows that an increase in the amount of DNA, DNP, and proteins is observed in the period up to 18 hrs; 24 hrs, 3, 7, and 14 days after irradiation a decrease in these indices is noted. Restoration of the function of the gland is observed after 30 days. These facts indicate a phase nature of the change in the function of the thyroid gland of irradiated animals. (tr-auth)

17640 (AEC-tr-7402, pp 90-99) PROTECTIVE ROLE OF AUTOANTIBODIES IN THE INITIAL PERIOD OF ACUTE RADIATION SICKNESS IN EXPERIMENTAL ANIMALS. Zhelenznikova, G. F. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 382-388(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

Preliminary immunization with homologous tissues and an aseptic inflammation suffered before irradiation reduced the severity of acute radiation sickness in its initial period in experiments on white rats and guinea pigs. This protective effect depended both on stimulation of nonspecific protective mechanisms and on intensified manufacture of autoantibodies in response to the given influence. In preliminarily immunized animals, a period of deterioration of the condition was observed at the second to third week of acute radiation sickness, which was apparently associated with the supplementary pathogenetic influence of autoimmunization. (tr-auth)

17641 (AEC-tr-7402, pp 100-111) INFLUENCE OF AMINAZINE ON THE RADIOPROTECTIVE AND TOXIC PROPERTIES OF MEXAMINE. Cherepkov, E. M.; Zherebchenko, P. G. (Inst. of Biophysics, Moscow). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 389-395(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

It was shown in experiments on mice and rats that aminazine in low doses reduces the toxicity of mexamine without thereby changing its ability to increase the survival of irradiated animals and reduce the degree of affection of the hematogenic organs. Aminazine does not reduce the spasm of the vessels of the spleen, bone marrow, small intestine, and hypoxia of the spleen caused by mexamine in rats, but it normalizes the disturbances of blood

supply associated with the use of the radioprotector in a number of other organs, including the brain. The latter effect is probably responsible for the antitoxic action of aminazine. (tr-auth)

17642 (AEC-tr-7402, pp 163-168) AMINO ACID COMPOSITION AND DACTYLOGRAPHIC ANALYSIS OF HEMOGLOBINS OF GUINEA PIGS IRRADIATED AT A DOSE OF 600 R. Sukhomlinov, B. F.; Zdravko, B. I. (Lvov State Univ.). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 431-434(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The amino acid composition and dactylograms of the hemoglobin of intact guinea pigs and guinea pigs irradiated at a dose of 600 R were investigated. Although no significant changes in the amino acid composition of the irradiated hemoglobin were detected, the appearance of supplementary peptides in the hemoglobin isolated from the erythrocytes of the irradiated guinea pigs, beginning with the first day of acute radiation pathology, was demonstrated by the method of dactylography. (tr-auth)

17643 (AEC-tr-7402, pp 169-172) POSTRADIATION RECOVERY OF SUPERMOLECULAR DNA IN THE SPLEENS OF GAMMA-IRRADIATED MICE UNDER PROTECTION OF AET. Struchkov, V. A.; Strazhevskaya, N. B.; Suslikov, V. I. (Inst. of Biological Physics, Pushchino, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 435-437(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The postradiation recovery of the elastoviscosity of supermolecular DNA (SM DNA) in the spleens of mice irradiated at sublethal doses of 150 and 600 R was established. Administration of AET to mice before irradiation facilitates and accelerates the repair of SM DNA. The weight of the spleen in the irradiated mice, as a rule, is restored more slowly than the elastoviscosity of the SM DNA. (tr-auth)

17644 (AEC-tr-7402, pp 179-183) ACTIVITY OF ALKALINE NUCLEASES OF THE SPINAL CORD DURING RADIATION SICKNESS. Kukharenko, R. I. (Dnepropetrovsk State Univ., USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 441-444 (1972).

In Radiobiology, Vol. 12, No. 3, 1972.

In the case of total x irradiation of cats at a dose of 1200 R, the activity of alkaline ribo- and deoxyribonucleases of the gray and white matter of the spinal cord is reduced. A decrease in the nuclease activity occurs 1 hr after irradiation, and is not restored up to five days. In the case of inactivation of the natural inhibitor of nucleases by p-chloromercury-benzoate, the ribonuclease activity is unchanged after irradiation, while the deoxyribonuclease activity is significantly reduced. The data are evidence that during radiation sickness, natural inhibitors participate in the regulation of the activity of tissue nucleases. (tr-auth)

17645 (AEC-tr-7402, pp 184-187) CONTENT OF UBIQUINONE IN THE LIVERS OF MAMMALS WITH DIFFERENT RADIOSENSITIVITIES. Zaslavskii, Yu. A.; Akoev, I. G. (Inst. of Biophysics, Pushchino, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 444-446(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The total content of ubiquinone and the ratio of its oxidized and reduced forms in a homogenate and in mitochondria of liver cells of rats, guinea pigs, and mice were investigated according to the method of Redfearn and Pumphrey. In the more radioresistant species of rats, the ubiquinone content in the liver of the intact animals was higher. The postradiation rise in the content of ubiquinone was also higher in the more radioresistant animals. The ratio between the oxidized and reduced forms of ubiquinone was essentially unchanged. (tr-auth)

17646 (AEC-tr-7402, pp 188-194) COPPER AND MANGANESE CONTENT IN THE ORGANS OF RABBITS UNDER THE INFLUENCE OF X RAYS. Savitskii, I. V.; Gotsulyak, L. E. (Odessa Medical Inst.). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 446-451(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

A single total irradiation of rabbits with x rays at a dose of 400 R causes regular changes in the copper and magnesium content in all the investigated tissues, which begin after 6 hrs and are maintained for 30 days. The deviations in the copper and manganese content in the organs are characterized by a bilateral direction of the changes with predominance of a decrease in the concentration of the so-called trace elements, especially copper, on the radiosensitive tissues. For manganese the indicated deviations and the tendencies of the shifts for individual tissues are less pronounced. (tr-auth)

17647 (AEC-tr-7402, pp 200-206) CHEMICAL PROTECTION OF NEWBORN MICE FROM THE INFLUENCE OF IONIZING RADIATION. Bogatyrev, A. V.; Timoshenko, S. I.; Sverdlov, A. G. (Ioffe Inst. of Physics and Tech., Leningrad). Translated from Radiobiologiya; 12: No. 3, 454-458(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The effectiveness of mexamine, cystaphos, cystamine, and a combination of mexamine with cystaphos in the irradiation of newborn mice at a dose of 700 R was studied. The most effective is cystamine (more than 60%). Mexamine and cystaphos when used separately have a weak protective effect, while in the case of combined administration of these protectors, their effects are additive, and the effectiveness of the combination approaches 50%. In a study of the long-term consequences of irradiation, cystamine proves to be considerably more effective than the other protectors, substantially lowering the frequency of impairment of coordination of movement and radiation cataract. (tr-auth)

17648 (AEC-tr-7402, pp 207-211) INFLUENCE OF TOTAL X IRRADIATION ON THE ARTERIAL PRESSURE OF THE DOG. Daniyarov, S. B. (Kirghiz Medical Inst., Frunze, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 458-461(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The influence of total irradiation at a dose of 600 R on the level of arterial pressure was investigated. The observations were conducted on 504 dogs in an acute experiment and on 17 dogs in a chronic experiment. It was established that among dogs the level of arterial pressure is essentially unchanged within the first week after irradiation and fluctuates within limits close to normal. A profound decrease in the arterial pressure was detected only several days and hours before the death of the animals. (tr-auth)

17649 (AEC-tr-7402, pp 212-214) MECHANISM OF THE INCREASE IN THE PERMEABILITY OF THE SKIN VESSELS IN THE PRESENCE OF LOCAL GAMMA IRRADIATION. Oyvin, I. A.; Gaponyuk, P. Ya.; Uklonskaya, L. I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 462-463(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

Preliminary subcutaneous injection of an inhibitor of tissue respiration (NaCN), which blocks the action of permeability factors, inhibits but does not eliminate the development of impairment of the permeability of the vessels in the case of local irradiation of the skin of rabbits at a dose of 9500 rad. (tr-auth)

17650 (YALE-3960-5) CATECHOLAMINE METABOLISM FOLLOWING X-IRRADIATION OF MAMMALS. (Yale Univ., New Haven, Conn. School of Medicine). 1973. AT(30-1)-3960. 10p. Dep. NTIS.

Progress is reported on the following research projects: catecholamine metabolism in whole-body x-irradiated rats; the effect of p-chlorophenylalanine and α-methyl-p-tyrosine on whole-body x-irradiated mice; radioprotective action of dopamine on whole-body x-irradiated rats; effects of dopamine on x-irradiated DNA; the effect of total-body irradiation on urinary catecholamines in man; and effects of x radiation and ultraviolet radiation on tyrosinase activity. (HLW)

17651 RADIOPROTECTIVE AND TOXIC EFFECTS OF S-2-(3-AMINOPROPYLAMINO)ETHYL PHOSPHOROTHIOIC ACID (WR-2721) ON THE DEVELOPMENT OF IMMUNOCOMPETENT CELLS. Yuhas, J. M. (Oak Ridge National Lab., TN). Cell. Immunol.; 4: 256-263(Jul 1972).

The toxic and radioprotective effects of S-2-(3-aminopropylamino)ethylphosphorothioic acid, or WR-2721, on the subsequent development of direct plaque-forming cells (DPFC) in the spleen of BALB/c mice following immunization with sheep red blood cells (SRBC) was studied. A single injection of the maximally tolerated dose of this drug, 500 mg/kg, accelerated the appearance of DPFC but reduced the eventually attained peak levels to as low as 20% of those observed in mice not receiving the drug. Analysis of closely related analogs of WR-2721 failed to uncover another radioprotective thiophosphate with similar effects on the immune response. Suppression of the peak DPFC levels persisted for 4 days after drug injection, followed by a gradual return toward normal responsiveness, which was attained by 10 days postinjection. Injection of the drug after the SRBC suppressed the development of DPFC, but the level of suppression decreased as the time between SRBC injection and drug injection increased. This suppression persisted for too long a period to be accounted for by the drug itself or one of its metabolites. It was concluded therefore that the drug affects a specific component of the immune response, that it requires 10 days for the integrity of the component to be reconstituted, and that the importance of this component declines as the immune response matures. A quantitative estimate of the protection that the drug affords the immune system against radiation injury was determined by exposing the mice to graded gamma exposures, with and without prior drug injection, and assaying the DPFC levels 90 days later, i.e., after sufficient time was allowed for recovery from drug toxicity and radiation injury. From the regressions of DPFC on radiation dose, it was shown that WR-2721, if given 15 min before radiation exposure, increased the resistance of the immune response to radiation injury by a factor of 3.4, (auth)

17652 ASPECTS OF NEUTRON THERAPY BASED ON AN ANALYSIS OF RELATIONSHIPS BETWEEN RBE AND DOSE. Alper, T. (Hammersmith Hospital, London). Brit. J. Radiol.; 45: No. 529, 39-47(Jan 1972).

The effect of quality change, (x radiation to fast neutrons) in reducing equivalent dose per fraction utilized in inflicting sub-lethal injury, is tabulated. Normal tissues considered were hemopoietic (mouse), intestinal mucosa (mouse), young cartilage (rat), skin (mouse, rat, pig, human). Experimental tumors considered were fibrosarcomas RIB_5 and RIB_{5c} (rats), mammary, spontaneous, (mouse), rhabdomyosarcoma (rat). The analysis suggests that although suitable animal experiments may enable reactions of normal human tissues to irradiation to be predicted with reasonable confidence, nothing can yet be suggested about which types of human tumor might be more successfully treated by neutrons than low LET radiations. All four animal tumors investigated demonstrated different modes of change in relation to RBE of dose fraction, and the tumor RIB_{5c}, derived from a culture in vitro of cells originating from RIB_5, displayed very different radiobiological characteristics from the original. (UK)

17653 TENSION OF OXYGEN IN THE MUSCLE OF ADRENALECTOMIZED AND IRRADIATED RATS UNDER ACUTE HYPOXIA. Akopyan, S. A.; Akopyan, N. S. (Erevan State Univ.). Biol. Zh. Arm.; 25: No. 6-7, 125-129(1972). (In Russian).

Mechanisms of oxygen exchange, the role of corticosteroids, and the effects of acute hypoxia (8,000 m) were studied by polarigraphic methods in rat muscle. Oxygen deficiency causes a disturbance in the normal regulation of the O_2 uptake by the tissues corresponding to the metabolic requirements. In the case of adrenalectomized and irradiated rats the restoration of the original oxygen pressure was slow and incomplete compared with the control animals. (KSW)

17654 RADIOSENSITIVITY OF VARIOUS TISSUES OF THE RAT WITH SPECIAL REGARD TO DEOXYCYTIDINE-2-^{14}C METABOLISM IN VITRO. Kang, M. S. Tongmul Hakhoe Ji; 15: No. 1, 1-14(1972).

The effect of 400R of whole-body x-irradiation on DNA synthesis, DNA degradation, CdR-aminohydrolase activity, and oxygen uptake in the liver, spleen, and thymus of the rat was studied in connection with the radiosensitivity of these tissues. The rate of CdR-2-^{14}C incorporation was followed during the postirradiation period and correlated with the increased levels of CdR-aminohydrolase activity. The postirradiation period comprises radiation reaction and tissue regeneration periods. During the period of radiation reaction, markedly decreased precursor incorporation, decreased tissue levels of DNA, and decreased uptake of oxygen are noted as well as an increase in the CdR-aminohydrolase activity. The period of regeneration appears to consist of two discrete phases. The first phase reveals a return of CdR-aminohydrolase activity and the second phase is highlighted by a markedly increased rate of labeled CdR incorporation. Various events occurring during the radiation reaction period and the regeneration period in the three tissues studied can be considered qualitatively the same, differing only in the degree of acute cell death, in the duration of the delay of DNA synthesis in the surviving cells, and in the rate of recovery resulting from accelerated cell replication during the period of regeneration. A possible biochemical mechanism involved in the DNA synthesis and degradation, in connection with the increased levels of CdR-aminohydrolase after irradiation, is briefly discussed. (auth)

17655 ERYTHROPOIETIC INJURY AND REGENERATING CAPACITY IN STARVED IRRADIATED RATS. Hajdukovic, S.; Dragic, M.; Antonijevic, M. Vojnosanit. Pregl.; 29: 145-150 (Mar 1972). (In Serbo-Croatian).

The synergistic effect of starvation and exposure to γ radiation on erythropoiesis in animals was studied. Starvation alone was known to cause significant erythropoietic changes, leading to nearly complete depression of the blood-forming function of the bone marrow; radiation was also known to cause marked changes. Experiments were carried out with starved and normally fed female rats, irradiated with 400 or 800 R following artificially induced polycythemia. The level of the response, evaluated by the number of reticulocytes, the appearance of ^{59}Fe in the peripheral blood, and the distribution of radioactive iron in the bone marrow, spleen, and liver after application of erythropoietin, was used as a measure of the regenerative capacity of erythropoietic tissue as a function of the number of days following the irradiation. The results did not reveal any difference in the postirradiation erythropoietic capacity between starved and normally fed rats. (TTT)

17656 NEGATIVE PION RADIOTHERAPY: PHYSICAL AND RADIOBIOLOGICAL ASPECTS. Raju, M. R.; Richman, C. (Univ. of California, Berkeley). Curr. Top. Radiat. Res. Quart.; 8: No. 2, 159-233(Oct 1972).

Radiobiological measurements of π^- mesons were restricted to a few systems because of low dose rate. The beam used had a contamination amounting to about 15% of the dose at the peak. Most biological measurements are made only at the beam entrance and at the peak of the depth dose distribution. The RBE at the beam entrance is very nearly the same as for conventional radiations, and the OER is expected to be the same as for conventional radiations. Depending on the biological end point and the system used, the RBE at the peak is in the region of 1.4 to 5; the OER values at the peak of the depth dose distribution are in the region of 1.5 to 1.9. For a pure pion beam the RBE values at the peak will be slightly higher and the OER slightly lower. However, these values change according to the width of the peak, i.e., with increasing width the RBE decreases and the OER increases. Negative π mesons, in addition to their good localization characteristics, offer the advantage for use for therapy of neoplasms of favorably influencing biological factors because of differences in the quality of radiation given to the treatment volume and the intervening normal tissues. By utilizing dose fractionation, the low dose to intervening normal tissues, with its low LET, allows these tissues to recover better than cells in the treatment volume. Thus, physical and radiobiological experiments indicate that π^- mesons could make significant improvements in radiotherapy. Pion beam intensities currently available are too low for therapeutic applications. Accelerators capable of producing adequate intensity of π^- mesons are being built at several locations. (CH)

17657 RECOVERY FROM SUB-LETHAL DAMAGE BY HYPOXIC TUMOUR CELLS IN VIVO. McNally, N. J. (Hammersmith Hospital, London). Brit. J. Radiol.; 45: No. 530, 116-120 (Feb 1972).

A method was developed whereby the survival of tumor cells irradiated in vivo can be measured in terms of their colony-forming ability in vitro. Using this technique, survival curves were constructed for tumors irradiated in various conditions of oxygenation. When tumors were exposed to two equal doses of radiation separated in time, cells were able to recover from their sub-lethal damage. The doses chosen were such that the ratio of surviving cells that were hypoxic at the time of the first dose of radiation to those that were well-oxygenated was at least 20 to 1. A consideration of the shapes of survival curves showed that not only were these hypoxic cells capable of recovery from sub-lethal damage, but they remained hypoxic for the time during which this process took place. The survival curve for cells from tumors exposed to a first dose of 1,000 rads and graded second doses five hours later confirmed this deduction. (auth)

17658 DISCRIMINATION BETWEEN VARIOUS DOSE LEVELS IN WHOLE-BODY IRRADIATED MICE, BY COUNTS OF BONE MARROW SAMPLES. Segreto, C.; Ludwig, F. C. (Escola Paulista de Medicina, Sao Paulo, Brazil). Int. J. Appl. Radiat. Isotop.; 23: No. 12, 545-548(Dec 1972).

The ratio of erythrocytes/nucleated cells (which can be determined in bone marrow samples of variable and unpredictable size) is positively correlated with the radiation dose. This can be used as a biological dosimeter to estimate clinically important dose levels in whole-body exposed mammals. (auth)

17659 EFFECT OF TEMPERATURE ACCLIMATION, TAIL AMPUTATION, AND X-IRRADIATION ON THYROID GLAND OF THE LIZARD, HEMIDACTYLUS LESCHENAULTI. Eapen, J.; Pushpendran, C. K. (Bhabha Atomic Research Centre, Bombay). Indian J. Exp. Biol.; 10: No. 4, 253-256(Jul 1972).

Thyroid activity is low in lizards acclimated to 24°C and amputation of tail brings about changes associated with elevated thyroid follicular activity. X irradiation does not affect the epithelial cells at 24°C. Tail amputation enhances epithelial cell height in spite of x irradiation. Thyroid follicles are activated following acclimation to 37°C. This heightened follicular activity is reduced after x irradiation and over a period of time after tail amputation. The results reveal temperature-dependent changes in the thyroid gland of house lizards. (auth)

17660 AMINO ACIDS AND TRANSAMINASES AspAT AND AlaAT IN THE BLOOD SERUM IN RATS IRRADIATED DURING FOETAL DEVELOPMENT. Rudnicki, T.; Wronski, A. (Instytut Nauk Fizjologicznych, Poznan, Poland). Acta Physiol. Pol.; 23: No. 5, 839-846(1972). (In Polish).

Growth, amino acid level, and transaminase activity in blood serum of rats exposed to radiation injury during prenatal development were studied. Eighty rads on the 8th or 150 rads on 17th day of gestation were given. The average weight of rats irradiated on the 17th day of prenatal development was 80% of controls on the 85th to 95th day of life. No changes in amino acid level were found. In rats irradiated on the 17th day of prenatal development the activity of both transaminases was about 150% or 200% of that in control animals. (auth)

17661 HEMATOPOIESIS INDICES OF CHICK EMBRYO DEVELOPED FROM EGGS IRRADIATED WITH VARIOUS DOSES OF GAMMA RAYS. Karapetyan, S. K.; Saakova, L. A. (Inst. of Physiology, Erevan). Biol. Zh. Arm.; 25: No. 1, 12-16(Jan 1972). (In Russian).

Chicken eggs were irradiated with 10, 25, and 75 R of γ radiation before incubation in order to study the dynamics of blood formation in embryos from irradiated eggs. Embryos were taken for study from the 5th day of development until hatching, and the concentration of erythrocytes, the quantity of hemoglobin, and the change in leucocyte content were investigated as functions of incubation time. A certain amount of random fluctuation was evident in all three graphs. It was concluded that erythropoiesis and leucopoiesis proceeded less uniformly in embryos from irradiated eggs than in the controls (non-irradiated). (KSW)

17662 THROMBOCYTOPOIETIC ACTIVITY OF BLOOD OF IRRADIATED ANIMALS. Batikyan, I. G.; Arutyunyan, R. A. Biol. Zh. Arm.; 25: No. 1, 100-102(Jan 1972). (In Russian).

The thrombocytopoietic activity of the blood of white rats which had been given 600 R of x-radiation was studied at periods of time from 1 to 17 days after irradiation. The plasma of rats during the first 15 days after irradiation acquired a high thrombocytopoietic activity. When transfusion of such blood to rat-recipients was conducted, a statistically reliable increase in the thrombocyte number was produced in the peripheral blood. (KSW)

17663 PRIMARY RESPONSE OF THE ADRENAL CORTEX TO IONIZING IRRADIATION IN COMPETITIVE PROTEIN BINDING (C.P.B.) ASSAY OF CORTICOSTERONE IN THE BLOOD OF IRRADIATED RATS. Lipski, S. (Osrodek Ochrony Radiologicznej i Radiobiologii, Warsaw). Acta Physiol. Pol.; 23: No. 5, 823-828 (1972.) (In Polish).

The corticosterone level was determined by the C. P. B. assay in the blood of rats irradiated with 840 R (x-rays). Irradiated and control animals were exposed to irradiation for 14 days. A significant increase in the corticosterone level was found 2 to 3 hours after irradiation. At an earlier time the response of the adrenal cortex was non-specific because of additional factors. (auth)

17664 RADIOPROTECTING ACTION OF C511 INJECTED INTO MICE, 24 HOURS BEFORE A LETHAL DOSE IRRADIATION. Frossard, H.; Fatome, M.; Cadot, M.; Bonnardot, C.; Sauvant, D. (Centre de Recherches du Service de Sante des Armees, Clamart, France). Compt. Rend., Ser. D; 275: No. 17, 1923-1925(23 Oct 1972). (In French).

The effect of C511 HF on mice given lethal dose whole-body irradiations (LD 100/30 days) was studied. It was concluded that the product affords protection to animals when it is injected intraperitoneally 2 or 24 hrs before the irradiation. (France)

17665 MANIFESTATION OF GENERAL IRRADIATION OF RAT INCISOR BY SUBLETHAL DOSE WITH SIMULTANEOUS SCREENING OF THE HEAD. Bily, B. (Stomatologicka Klinika, Brno). Cesk. Stomatol.; 72: No. 3, 135-139(May 1972). (In Czech).

The indirect effect of x rays on the tissues of rat incisor teeth on irradiation by sublethal dose 500 R with simultaneous screening of the head by a lead cover at periods of 4, 7, 14, and 28 days after irradiation was observed. Hyalinization in the vicinity of layer of odontoblasts and origin of islets from osteodentin in their vicinity appeared in the apical half of the incisor as a result of indirect irradiation. It is supposed, that primary hyalinization of dental marrow occurs in the vicinity of layer of odontoblasts and in apical region of rat incisor after indirect irradiation. Substances causing the permeability of venous endothelium and other tissue structures were carried by blood in the region of dental marrow. Hyaluronidase, histamine, and similar substances are very important; their level increases after x irradiation, causing the changed permeability of protein components of cellular mass into intercellular spaces. It concerns especially hyalin, which later mineralizes and has the appearance of osteodentin islets. (auth)

17666 NEW RADIOPROTECTOR, C511: RESULTS OBTAINED WITH ANIMALS. Frossard, H.; Fatome, M.; Perles, R. (Centre de Recherches du Service de Sante des Armees, Clamart, France). pp 89-98 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

A new molecule, C 511, belonging to an original chemical family, has shown interesting radioprotective properties. From experiments carried out on mice and rats, C 511 is at least as active as proven standard radiation protectors, namely: AET, cystamine, serotonin, and has the advantage of being less toxic. (France)

17667 INVESTIGATION OF RADIATION- AND LITHIUM CHLORIDE-INDUCED CONDITIONED TASTE AVERSIONS. Barker, L. M. Tallahassee; Florida State Univ. (1972). 164p. University Microfilms Order No. 72-34,021.

Thesis (Ph.D.).

Radiation- and lithium chloride-induced taste aversions were investigated in rats in a series of experiments. In Experiment I, conditioned taste aversions were produced following pairings of 0.1% saccharin solution (CS) with either 50, 100, or 200 roentgens of ionizing radiation (US) following a six hour CS–US interstimulus interval, but no aversion was found following comparable pairings using dosages up to 2.0% body weight, 0.15M LiCl injections as the US. In Experiment II, it was demonstrated that LiCl injections were incapable of producing conditioned taste aversions in a US–CS (backward) conditioning paradigm. This finding was contrasted with previous demonstrations of backward conditioning using an ionizing radiation unconditioned stimulus. In Experiment III, the relationship of quantitative and qualitative manipulations of the taste CS to the magnitude and resistance-to-extinction of conditioned taste aversions was investigated. Conditioned taste aversion was demonstrated to be a direct function of both the concentration and duration of the conditioned stimulus. (Diss. Abstr. Int., B)

17668 EFFECT OF EPSILON-AMINO-n-CAPROIC ACID (EACA) ON RADIATION-INDUCED INCREASE IN CAPILLARY PERMEABILITY. Eassa, E. H. M.; Casarett, G. W. (Univ. of Rochester, NY). Radiology; 106: No. 3, 679-688(Mar 1973). (UR-3490-26).

Effects of a single intravenous injection of EACA administered at various times before or after single localized x-ray exposure of rabbit skin on temporal patterns and degrees of initial and delayed radiation-induced capillary permeability, as indicated by leakage of dye into irradiated skin, were studied. Minimal x-ray exposure to induce visibly detectable leakage of dye within 3 hrs was 450 R. Average time between irradiation and first sign of increased capillary permeability, and duration of this initial period were inversely dose-dependent. EACA, injected intravenously within an hour before to an hour after irradiation, decreased or abolished initial radiation-induced increase in capillary permeability. (auth)

17669 EFFECTS OF SINGLE DOSE AND OF FRACTIONATED RADIATION ON RABBIT BONE MARROW. Hill, D. R.; Price, D. C.; Kane, L. J.; Phillips, T. L. (Univ. of California, San Francisco). Radiology; 106: No. 3, 695-698(Mar 1973).

The right lower extremity of young adult New Zealand rabbits was irradiated with various dosages and fractionation schedules. The left lower extremity served as the control. Six weeks after irradiation, marrow uptake of ^{59}Fe and ^{99m}Tc was measured and marrow cellularity counts were taken. For all radiation dosages and fractionation schedules there was a significant correlation between the isotope uptakes and an apparent correlation between the ^{99m}Tc label and marrow cellularity. (auth)

17670 RADIATION PROTECTIVE EFFECT OF A MIXTURE OF ATP, AET, AND SEROTONIN ON YIELDS OF 600-R X-RAY-INDUCED CHROMOSOME ABERRATIONS IN THE RAT. Baev, I.; Benova, D. (Research Inst. on Radiology and Radiation Hygiene, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 8, 1129-1131 (1972).

The effects of the administration of a mixture of AET, ATP, and serotonin on the chromosome aberration yield in bone marrow cells of mice exposed to x rays at a dose of 600 R was studied. Administration of the mixture prior to exposure significantly reduced the chromosome aberration yield. (ERB)

17671 ROLE OF PHOSPHOLIPIDS IN IRRADIATION INJURY OF MAMMALS WITH DIFFERENT DEGREES OF RADIOSENSITIVITY. Ryazanov, V. M.; Stakanov, V. A. Vestn. Mosk. Univ., Biol. Pochvoved.; No. 6, 107-108(1971). (In Russian).

Prior to their exposure to a 700 rad dose of radiation, white rats and guinea pigs were found to have the same overall percentages of phospholipids in the tissues of their livers, brains, and small intestines, although the phospholipid content of total lipids was higher in guinea pigs than in rats. Following irradiation, this index declined steadily in guinea pigs, but in white rats it increased, remained constant for 4 to 5 days, then dropped. As for the overall phospholipid content, it showed a significant decrease in both species. This corroborated the fact that oxidizing chain reactions occur after exposure to radiation and result in the formation of lipid radiotoxins and the breakdown of natural phospholipid antioxidants. This fact also helped to explain the decrease in the antioxidizing activity of phospholipids which was observed in both species. (JPRS)

17672 STUDY OF THE ACTIVITY OF DESOXYRIBONUCLEASES IN THE URINE OF MONKEYS DURING THE ACUTE RADI-

ATION SICKNESS. Moskaleva, E. Yu. Byull. Eksp. Biol. Med.; 74: No. 11, 28-30(Nov 1972). (In Russian).

There was revealed a depression of DNA-ase I activity in the urine of monkeys on the 1st–8th day after irradiation in a dose of 620 R ($^{80-90/45}$LD) and a rise of DNA-ase I and DNA-ase II activity on the 20th–30th day. Urinary protein excretion was no different from the normal up to the 8th day and exceeded it from the 10th to the 30th day. An increase in DNA-ase activity at that period correlated with the beginning of hemopoietic tissue regeneration. (auth)

17673 X-RAY- AND UV-INDUCED INCREASE IN NUMBER OF CYSTEINE-RICH PERIVENTRICULAR GLIAL CELLS IN THE BRAINS OF RATS AND MICE. Srebro, Z.; Lach, H. (Inst. of Biomorphology, Krakow). Acta Biol. Acad. Sci. Hung.; 23: No. 2, 145-151(1972).

The number of cysteine-rich (Gomori-positive) periventricular glial cells in the rat brain was found to be significantly increased 7 days after 3,000 and 4,000 R x-irradiation of the head region. The number of these cells also increased after 14 to 28 days of whole-body uv-irradiation. The cysteine-rich granulations of the periventricular glia are peroxisome-like organelles probably involved in decomposition of organic peroxides. (auth)

17674 EFFECT OF X-RAYS ON THE MITOTIC REGIMEN OF THE CORNEAL EPITHELIUM IN ALBINO MICE. Uryupina, N. V. (Kursk Medical Inst., USSR). Byull. Eksp. Biol. Med.; 74: No. 11, 90-93(Nov 1972). (In Russian).

A study was made of mitotic regimen of the corneal epithelium in albino mice following total irradiation (200 R) in the morning and in the evening; marked 24-hour variations in mitotic activity proved to occur after the x-ray action both in the morning and in the evening. Because reaction of the cells to irradiation differed at different times of the day, a more pronounced antimitotic effect followed irradiation in the evening. Total irradiation of animals led to the appearance of a considerable amount of pathological forms of mitosis in the corneal epithelium, particularly following irradiation in the morning. (auth)

Invertebrates

17675 (AEC-tr-7402, pp 173-178) CHANGE IN THE INTENSITY OF OXIDATIVE PHOSPHORYLATION AND THE ACTIVITY OF CATALASE DURING IRRADIATION OF VARIOUS SPECIES OF INVERTEBRATES. Kostromskaya, V. A. (Sverdlovsk Medical Inst., USSR). Feb 1973. Translated from Radiobiologiya; 12: No. 3, 437-441(1972).

In Radiobiology, Vol. 12, No. 3, 1972.

The respiration, oxidative phosphorylation, and catalase activity in the phylogenesis of invertebrates in the normal state and 1.5 hrs after irradiation with ^{60}Co at a dose of 1425 rad were investigated. In tissue homogenates and mitochondria of certain invertebrates the rate of absorption of oxygen was determined by the Warburg method, the consumption of inorganic phosphate by the Fiske–Subbarrow method, and the catalase activity by the method of Bakh and Zhubkova. In all the investigated animals, a low level of oxidative phosphorylation in the normal state, a decrease in its intensity after irradiation, and a drop in the catalase activity were noted. (tr-auth)

17676 (CONF-711148–, pp 487-510) RESPONSE TO IRRADIATED FOODS AND RADIOSENSITIVITY OF SYNCHRONIZED TETRAHYMENA PYRIFORMIS W. CELLS. Srinivas, H.; Vakil, U. K.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). 1971.

From Symposium on Cellular Processes in Growth, Development and Differentiation; Bombay, India (22 Nov 1971).

Growth response of Tetrahymena pyriformis W, a protozoan with 25°C for optimum growth, is known to be related to quality of protein used in the assay medium. Based on this characteristic, the organism was employed in the assessment of protein quality in irradiated foods such as shrimps, wheat, and isolated wheat proteins. For this purpose, the organism was successfully cultured for synchronous growth through six intermittant heat shock treatments (34°C for 30 min each followed by 30 min periods of cooling). Under these conditions, about 90% of the cells could be induced to undergo simultaneous cytoplasmic fission in 95 min. Synchrony in cell growth was reflected in the rate of incorporation of DL-^{14}C-leucine when compared with normal cells. When synchronized cells, harvested on the fourth day, were grown in media irradiated (20 Krad to 1.0 Mrad) all together or with respect to individual components, there were no deleterious effects on growth for up to four successive transfers. Other studies on the effect of gamma-irradiation on survival of the synchronously grown organism showed that LD_{50} is 250 Krads when irradiation was carried out as a single operation; radio-resistance was increased when the cells were subjected to split doses of 50 Krads at intervals of 90 min. Cell-membrane constituents containing mucopolysaccharides remained unchanged, but cell permeability was affected by radiation treatment. (auth)

17677 DEVELOPMENTAL EFFECTS OF IONIZING RADIATION IN AEDES AEGYPTI. Asman, M.; Rai, K. S. (Univ. of Notre Dame, IN). J. Med. Entomol.; 9: No. 5, 468-478(30 Sep 1972). (COO-38-482).

All stages of Aedes aegypti were exposed to radiation in doses ranging from 500 to 32,000 R. A 10,000 cu ^{60}Co source, delivering approximately 125 R/min was used to determine the radiosensitivity relating to egg hatch, growth and development, viability to adulthood, longevity, cell division, as well as fecundity and fertility in both sexes. Fully embryonated eggs exposed to 500 R resulted in retarded development of larvae hatching from them but proved to be more radioresistant than eggs undergoing embryonation. Prolonged developmental time was related to a decrease in mitotic rate. The greater sensitivity of the 1st 3 larval stages over embryonated eggs appeared to be due to mitotic activity in the larval stages and its absence in quiescent eggs. Damage on the whole was directly proportional to dose and indirectly proportional to the stage of development reached; e.g., adult longevity was decreased when young larvae were exposed to 500 R, and when pupae and adults received 8000 R or more. The reproductive systems of both sexes were highly sensitive but fecundity and fertility were not affected to the same extent in the two. While treatment in all stages retarded or completely inhibited gonadal development and function, a low dose of 500 R to females in the 1st instar initiated a statistically significant increase in egg fecundity. Female sterility was achieved with a lack of fecundity at exposures of 4000 R to pupae and adults. Male sterility was related to production of infertile sperm at exposures of 8000 R. Cytological studies of gonads in control and treated organisms provided evidence for the observed radiation-induced decrease in reproductive potential. (auth)

17678 SEX PHEROMONE PRODUCTION IN IRRADIATED MALES OF DACUS (STRUMETA) TRYONI. Fletcher, B. S.; Giannakakis, A. (Univ. of Sydney). J. Econ. Entomol.; 66: No. 1, 62-64(Feb 1973).

The effect of sterilizing doses of irradiation on pheromone production in male Dacus tryoni (Froggatt) was determined by bioassay. Exposure of the pharate adult to 8000 or 20,000 rad on the 9th day in the puparium had no detectable effects on pheromone production as indicated by the percentage response of females. However, exposure to 5000 rad on the 5th day in the puparium caused a significant decrease in pheromone production. (auth)

17679 POPULATION DEVELOPMENT OF ACARUS SIRO REARED AT THREE TEMPERATURES FOLLOWING GAMMA IRRADIATION. Banditsing, C.; Hunter, P. E. (Univ. of Georgia, Athens). J. Econ. Entomol.; 66: No. 1, 82-85(Feb 1973).

Adults of the grain mite, Acarus siro L., were exposed to sublethal doses of gamma irradiation (0–10 kR), then reared at temperatures of 5, 15, or 25°C. The composition of the population at each temperature was counted every 8 days for 60 days. There was a negative correlation between the total mite population at 60 days and both rearing temperature and irradiation. Interaction between temperature and irradiation was significant, with temperature being over 800 times more effective than irradiation in reducing the mite population. An increase in population occurred at dose levels of 1 to 5 kR in the F_1 or F_2 generation. However, a significant detrimental long-range (F_1 or more) effect resulted from the sublethal irradiation dose of the F_p generation. (auth)

17680 COMPARATIVE SPECIES RADIATION SENSITIVITIES OF FLOUR BEETLES TO CHRONIC γ RADIATION. Erdman, H. E. (Pacific Northwest Lab., Richland, WA). Contract AT(45-1)-1830. J. Econ. Entomol.; 66: No. 1, 251-252(Feb 1973).

Populations of Tribolium confusum and T. castaneum were exposed to chronic γ radiation from a ^{60}Co source. Numbers of larvae and adults were determined at monthly censuses. A table is presented to show the influence of temperature, developmental time, dose, species, and cohabitation on populations after 18 months' chronic exposure. Increased temperature was associated with increased severity of radiation effects, accelerated metabolism, and enhanced cell divisions. T. confusum was more radioresistant than T. castaneum. (HLW)

17681 DROSOPHILA MELANOGASTER: EFFECTS OF γ RADIATION ON FECUNDITY AND LONGEVITY. Nelson, F. R. S. (Univ. of Massachusetts, Amherst). J. Econ. Entomol.; 66: No. 1, 257-258(Feb 1973).

One- or two-day old male flies were exposed to 5, 12, or 15 krad of γ radiation at a dose rate of 227 rad/min. Irradiated males were mated to unirradiated females and observations were made on the number of F_1 progeny and longevity of the irradiated males. Graphs are presented to show effects of radiation dose on reduc-

tion of progeny of irradiated males and reduction of male longevity. (HLW)

17682 RADIATION-INDUCED PARACENTRIC INVERSION IN AEDES AEGYPTI (L.). Cytogenetic and interchromosomal effects. McGivern, J. J.; Rai, K. S. (Univ. of Notre Dame, IN). (COO-38-854). J. Hered.; 63: No. 5, 247-255(1972).

A paracentric inversion in one of the autosomes (linkage group II) in the yellow fever mosquito, Aedes aegypti, was induced by gamma irradiation. This inversion was originally detected through suppression of recombination in a certain segment of linkage group II and confirmed by cytological analysis. Female inversion heterozygotes showed normal fertility (approximately 85 percent), while the fertility of the males heterozygous for the inversion was approximately 45 percent. Attempts to isolate inversion homozygotes were unsuccessful. Backcrosses involving females heterozygous for the inversion and certain markers in linkage groups I and III, and karyotypically normal multiple marker stocks, showed a significant increase in crossing over indicating interchromosomal effects of this inversion on recombination. (auth)

17683 MODIFICATIONS IN THE THERMOGENESIS OF CERATITIS CAPITATA DURING THE PUPARIUM STATE PRODUCED BY X-RAYS. Lemaitre-Boyeaux, C. (Lyon Univ., Villeurbanne, France). Compt. Rend., Ser. D; 275: No. 5, 687-690(31 Jul 1972). (In French).

The effect of x rays on the thermogenesis of Ceratitis capitata inside the puparium was studied. The specimens were subjected (at the same age) to radiation doses of between 100 and 10,000 rads. The thermogenesis of the reference specimens and that of the irradiated specimens (100, 500, and 1000 rads) varied during the puparium state in such a way as to give a U-shaped curve. In excess of 1500 rads, the descending branch of the irradiated specimen curve does not differ very significantly from that of the reference specimens. However, the second part of the curves bears no resemblance whatsoever to that of the reference specimens. (France)

Radionuclide Effects (Internal Source)

Refer also to abstract 17293.

Man

Refer also to abstracts 17590 and 19343.

17684 (BNWL-SA-3354) PRESENT AND PROJECTED SOURCES OF ENVIRONMENTAL RADIATION (THE GIVENS). Unruh, C. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jun 1970. Contract AT(45-1)-1830. 13p. (CONF-700609-4). Dep. NTIS.

From 15th Annual Meeting of the Health Physics Society, Chicago, Illinois, United States of America (USA) (28 Jun 1970).

The generation of fission product waste from nuclear fuels is discussed with the control of waste from both fossil and nuclear fuels emphasized. It is pointed out that tritium and ^{85}Kr are released directly to the environment due to the lack of technology capable of collecting and concentrating these radionuclides for storage. The production of tritium in nuclear reactors is discussed with regard to the mechanisms of neutron addition to deuterium, generation as a fission product, and nuclear reactions of neutrons with coolant additives or control rods containing boron or lithium. The release of ^{85}Kr from fuel reprocessing plants is discussed. Tables are presented to show predicted production rates and inventories of tritium and ^{85}Kr through the year 2000. The contribution of Plowshare activities and nuclear testing to the release of tritium and ^{85}Kr is discussed. A consideration of radiation doses indicates that dose contributions are expected to be nominal for the worldwide distribution of tritium and ^{85}Kr through the year 2000. (HLW)

17685 (COO-3019-2) ENVIRONMENTAL BEHAVIOR OF RADIOACTIVE SODIUM: TRANSPORT, UPTAKE, AND POPULATION DOSE. Tadmor, J. (Harvard Univ., Boston, Mass. Harvard Air Cleaning Lab.). Oct 1972. 117p. Dep. NTIS.

A theoretical evaluation was made of the consequences of an environmental release of an airborne cloud resulting from a sodium fire in an LMFBR. The evaluation takes into consideration only the hazards of the radioisotopes of the sodium. Problems associated with accompanying fission products were not included. On the basis of conservative assumptions, the data show that the most significant exposure would be to a child through the forage-cow-milk food chain pathway. The whole body dose for an instantaneous direct environmental release of 1 gram of sodium (containing 0.31 Ci of ^{24}Na and 1.8×10^{-4} Ci of ^{22}Na) would be about 0.2 rem; the corresponding dose resulting from a release of 1000 grams of sodium within the reactor containment vessel, followed by a subsequent containment vessel leakage rate of 0.1% per day, would be about 13 rems. Restrictions on the use of milk and milk products would considerably reduce these values. Other possible countermeasures that might be taken to cope with the environmental hazards are also discussed. Supplementing the report are appendices containing data on the properties and environmental behavior of sodium as well as information on computer models for evaluating the environmental transport of sodium and its compounds. (auth)

17686 (RFP-Trans-130) RADIATION ABSORBED DOSE IN THE LUNGS FROM RADIOACTIVE AEROSOLS. Zalmanzon, Yu. E.; Chutkin, O. A. Translated for Dow Chemical U. S. A., Rocky Flats Div., from Med. Radiol.; 17: No. 4, 63-68(1972). 10p. Dep. NTIS.

A study was made of the variation in radiation dose to the lungs following the inhalation of radioactive aerosols as a function of particle size. Calculations were made for the parameters of the distribution of aerosol particles according to measurements which are within the limits actually existing in practice, using recent international recommendations. Using the most important and dangerous isotope, ^{239}Pu as an example, it was found that with the same concentration of radioactive aerosol, the absorbed dose to the lungs could vary by a factor of several hundred. (auth)

17687 EPIDEMIOLOGIC STUDIES OF OCCUPATIONAL DISEASES. Cralley, L. J. (Public Health Service, Cincinnati). pp 1-69 of Industrial Environmental Health. The Worker and the Community. /Cralley, L. V. (ed.). New York; Academic Press Inc. (1972).

The impact of Public Law 91-596, Occupational Safety and Health Act of 1970, on epidemiological studies of occupational diseases in persons exposed to potentially toxic substances or harmful physical agents is discussed. Data are summarized on the health status of workers at risk and parameters used to measure single and multiple on-the-job stresses in the workers under study. Information is reviewed from epidemiological studies of occupational diseases induced by stresses caused by exposure to some 30 chemical agents, including uranium. Data are reviewed from epidemiological studies of mortality of uranium miners in relation to radiation exposure, hard rock mining accidents, cigarette smoking, and incidence of lung cancer. Standards for maximum permissible occupational exposure to radon daughters in underground uranium mines are reviewed and it is noted that between 1957 and 1971 the recommended exposure levels were progressively lowered. The standards of the Department of the Interior, Department of Labor, and the Federal Radiation Council are compared and the need for additional characterization of the hazards from uranium mine air and accurate measurements of β and γ activity in uranium mine air is stressed. It is pointed out that a number of dosimeters designed for measuring cumulative α exposure from radon daughters failed to give acceptable results when worn by working miners. Methods under investigation for in vitro and in vivo monitoring of radon daughters are discussed. (CH)

17688 POSSIBILITY OF WORKING IN AN ATMOSPHERE CONTAMINATED WITH A LEVEL OF RADIATION HUNDREDS OR THOUSANDS OF TIMES GREATER THAN THE MPC. Schaeffer, R.; Delpla, M. (Electricite de France, Paris). pp 67-88 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The MPC (maximum permissible concentration) does not represent a limit for short periods of exposure to a contaminated atmosphere. The EDF regulations are in accordance with the ICRP (International Commission on Radiological Protection) recommendations, and tolerate, if avoidance is impossible, the inhaling on a single occasion of the quantity of radioisotopes that would be inhaled over a period of 3 months by an individual exposed to the MPC. Such a level of contamination corresponds to 2200(MPC)h. After inhaling during a time, t, a quantity of a radioisotope having a halflife, which is long with respect to t, and a given activity, the ICRP normalized man would receive a dose twice as high as the dose that he would have received had he inhaled the radioisotope during an extended period of time. In spite of this, it is shown that the inhaling of 2200(MPC)h on a single occasion does not lead to the exceeding of the maximum permissible dose; the absorbed dose may even be as low as 2% of the limit with nuclides having effective infinite halflives. The normalized man is essentially a theoretical model. However, the conclusions drawn have been verified from calculations made concerning individuals accidentally contaminated with radioisotopes produced in nuclear power plants. (France)

17689 DISTRIBUTION OF ABSORBED DOSE FROM ALPHA-ACTIVE AEROSOL PARTICLES BY TISSUE DEPTH. Zalmanzon, Yu. E.; Chutkin, O. A. (Scientific-Research Inst. of Instrument Construction, Moscow). Med. Radiol.; 17: No. 7, 69-72(Jul 1972). (In Russian).

Calculations of tissue absorbed dose dependence on the distance from alpha-active isotope aerosol particle considering irregularity of linear losses of α radiation along the path and real energetic spectra of aerosol particles were carried out. The calculated results for ^{239}Pu are presented. It is shown that dose distribution by tissue depth is a highly variable function; this must be considered in assessment of α-active aerosol hazards for personnel. (auth)

Animals

Refer also to abstracts 17548, 17621, and 17676.

17690 (AEC-tr-7397, pp 65-73) ROLE OF CELL POLYPLOIDY IN POST-RADIATION LIVER REGENERATION. Romanova, L. F.; Strel'tsova, V. N. (Inst. of Biophysics, Moscow). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 529-534(1972).

In Radiobiology, Vol. 12, No. 4, 1972.

A model of prolonged continuous irradiation of the organism by an incorporated hepatotropic isotope, ^{144}Ce, was used in examining the forms of repair to the liver parenchyma. The role of endomitosis and polyploidization of hepatocytes as one of the leading forms of post-radiation recovery was demonstrated. (tr-auth)

17691 (AEC-tr-7397, pp 109-116) BIOLOGICAL EFFECT OF ^{14}C INCORPORATED IN FISH EGGS. Fedorova, G. V. (State Scientific Research Inst. of Lake and River Fishing, Leningrad). Jan 1973. Translated from Radiobiologiya; 12: No. 4, 561-565 (1972).

In Radiobiology, Vol. 12, No. 4, 1972.

The biological effect of ^{14}C in various doses incorporated in the eggs of Coregonus peled (Gmel) was compared with the influence of doses from external ionizing radiation (γ and x rays) and from strontium-90. (tr-auth)

17692 DOSIMETRY AND BIOLOGICAL CONSEQUENCES OF THE AUGER ELECTRON EFFECT. WHOLE-BODY COUNTING WITH INTRANUCLEAR ^{125}I-DEOXYURIDINE. Ertl, H. H. Duesseldorf; Univ. Duesseldorf (1970). 56p. (In German).

Thesis.

The decay of ^{125}I is accompanied by the emission of Auger electrons. Following incorporation of this isotope in the DNA of synthetizing cells by means of ^{125}I-deoxyuridine, an artificial DNA precursor and thymidine analogue, its biological effect was investigated and compared with that of analogously incorporated ^{3}H-thymidine. Whereas the biological toxicity of tritium is almost entirely due to its β decay, the toxicity of ^{125}I can be attributed to its radiation effect and to molecular reactions. The decay data of ^{125}I were used to calculate its Auger cascade as well as the electron, x-ray, and γ emission, part of which were measured. Dosimetric considerations showed that the radiation dose absorbed from ^{125}I within a cell nucleus with a homogeneous activity is three times higher than the dose absorbed from ^{3}H. The biological effect of both isotopes was determined in vivo in mice by means of whole-body counting. For this purpose, 3 μCi of ^{131}I-deoxyuridine was injected iv into the animals and the excretion rate of this γ emitting tracer, which is likewise incorporated into the DNA, was measured over a period of 16 days. A change in the excretion rate as a function of simultaneously injected ^{125}I and ^{3}H activities can be seen from the reaction of the affected cells. The measurements showed that the incorporated ^{125}I is more toxic than a corresponding ^{3}H activity. The increase in the toxicity exceeded the factor 3 expected on the grounds of the energy deposition. Three days after the injection, a value of 5 could be measured, which rose to a value of 25 after 14 days. As backscattering and chemical transmutation can be excluded as possible reasons for this higher toxicity of the ^{125}I, it is attributed to the dense energy deposition of the three low-energetic Auger electrons per ^{125}I decay, as well as to the above-mentioned molecular mechanism. (GF)

17693 EFFECT OF DUST ON RARE-EARTH METALS CONTAINING A RADIOACTIVE COMPONENT ON THE ORIGINATION OF RETICULOSARCOMA OF THE LUNGS. Likhachev, Yu. P.; Lyarskii, P. P.; Elovskaya, L. T. (Inst. of Hygiene and Occupational Disease, Moscow). Byull. Eksp. Biol. Med.; 74: No. 11, 78-81(Nov 1972). (In Russian).

The origin of reticular tumors of the lungs as a result of intratracheal introduction of various dusts and concentrates with different specific radioactivity was studied. By the 15th to 21st month after the introduction of the dust, tumors of the lungs developed 8 to 10 times more frequently than in controls. Their formation is associated with dust and radioactive factors, the latter being of greater importance in this respect because an increase of dust radioactivity was accompanied by an increase in the incidence of tumors. There was a distinct prevalence of reticulosarcomas over the epithelial tumors. (auth)

Plants

17694 INVESTIGATIONS ON THE UPTAKE OF RADIOACTIVE ELEMENTS BY KALE FROM SOIL AND ATMOSPHERE AND ATTEMPTS OF DECONTAMINATION. Rohleder, K. (Staatliches Chemisches Untersuchungsamt, Brunswick). Z. Lebensm.-Untersuch. Forsch.; 149: No. 4, 223-7(1972). (In German).

Investigations were reported on the uptake of ^{90}Sr, ^{137}Cs, and ^{95}Zr by kale and with attempts of decontamination. The surface of the leaves mainly took up ^{95}Zr and ^{137}C and the roots ^{90}Sr. Apparently, the uptake of ^{137}Cs and ^{90}Sr from soil is related to the amount of precipitation. In spite of treating kale leaves with hot water for some time, decontamination was possible to only a small extent. (GF)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 17017 and 17717.

17695 (CONF-721209-2) PLEA FOR THE HEALTH PHYSICIST. Snyder, W. S. (Oak Ridge National Lab., Tenn.). 1972. 4p. Dep. NTIS.

The advantages of the early administration of DTPA to personnel following the uptake of Pu are stressed. The advantages of collecting one urine specimen before administering DTPA for evaluating the level of Pu exposure are discussed. (CH)

17696 (LA-5148) TWENTY-SEVEN YEAR STUDY OF SELECTED LOS ALAMOS PLUTONIUM WORKERS. Hempelmann, L. H.; Richmond, C. R.; Voelz, G. L. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 34p. Dep. NTIS.

Twenty-five male subjects who worked with plutonium during World War II under extraordinarily crude working conditions have been followed medically for a period of 27 years. Within the past year, 21 of these men have been examined at the Los Alamos Scientific Laboratory, and 3 more will be studied in 1973. In addition to physical examinations and laboratory studies (complete blood count, blood chemistry profile, and urinalysis), roentgenograms were taken of the chest, pelvis, knee, and teeth. The chromosomes of lymphocytes cultured from the peripheral blood and cells exfoliated from the pulmonary tract were also studied. Urine specimens assayed for plutonium gave a calculated current body burden (excluding the lungs) ranging from 0.005 to 0.42 μCi, and low-energy radiation emitted by internally deposited transuranic elements in the chest disclosed lung burdens probably of less than approximately 0.01 μCi. To date, none of the medical findings in the group can be attributed definitely to internally deposited plutonium. The bronchial cells of several of the subjects showed moderate to marked metaplastic change, but the significance of these changes is not clear. Diseases and physical changes characteristic of a male population entering its sixth decade were observed. Because of the small body burdens on the order of the maximum permissible level in these men so heavily exposed to plutonium compounds, we conclude that the body has protective mechanisms that are effective in discriminating against these materials following some types of occupational exposures. This is presumably explained by the insolubility of many of its compounds. Plutonium is more toxic than radium if deposited in certain body tissues, especially bone; however, from the practical point of view, plutonium seems to be less hazardous to handle. (auth)

17697 ALKALINE EARTH METABOLISM IN ADULT MAN. A report prepared by a task group of Committee 2 of the International Commission on Radiological Protection. Oxford; Pergamon Press (1973). 99p. (ICRP-20).

A new whole body retention function is presented. The human data considered in developing the model range from 15 min to 50 years after injection and include bone, calcium, strontium, barium, and radium. The results are presented in four ways: summary graphs of the whole body and internal retention functions for each alkaline earth from 10^{-2} to 10^{5} days after intravenous injection; twenty-six graphs that compare the model with the data

available; tables of the eight retention functions for each alkaline earth from 15 min to 87 years after injection; and tables of integrals of the retention functions for each alkaline earth isotope (including radioactive decay) to 1 year and to 50 years after injection. The model is intended to be useful both as a tool for further metabolic research and for calculating radiation doses to special groups of cells in human bone. Estimates are given of the accuracy of the new model, and the new model is compared with existing models. (UK)

17698 ^{90}Sr IN DECIDUOUS TEETH COLLECTED IN HELSINKI FROM CHILDREN BORN IN 1956–1963. Rytomaa, I. (Univ. of Helsinki). Acta Odontol. Scand.; 29: No. 3, 327-336 (1971).

Strontium-90 concentrations were measured by means of Cherenkov radiation in deciduous teeth collected in Helsinki from children born in 1956 to 1963. The mean ^{90}Sr content in those born in 1956 was 1.8 pCi/gCa; it increased to a value of 2.6 pCi/gCa in 1958 and remained at the same level for the next 2 to 3 years. Thereafter a sharp increase occurred, reaching a value of 6.8 pCi/gCa in children born in 1963. (auth)

17699 INVESTIGATION OF CONTAMINATION SOURCES BY ^{210}Po OF URANIUM MINERS. Panov, D.; Petrovic, D.; Novak, L. J.; Kilibarda, M. pp 215-31 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

A long-term investigation of the sources of radioactive contamination of uranium miners in Yugoslavia was effected by ^{210}Po evaluation. It was established that radon and its daughter products represent the most important source of contamination. ^{210}Pu estimations revealed body burdens as high as 2.9×10^{-9} after 5 yrs work in the mines. Dust analysis established that the miners are contaminated by 3.1 to 20.59 pCi per day. Food contamination involves 16.6 pCi per day, only 4.5% being deposited in the organism. Smokers are contaminated by 1.5 pCi per day. (France)

17700 ESTIMATION OF THE EQUIVALENT TOTAL DOSE DELIVERED TO THE BASAL LAYERS OF THE SKIN CONTAMINATED BY A $\beta-\gamma$ EMITTER: HYPOTHESIS ON THE DISTRIBUTION OF THE CONTAMINATION; APPARENT DEPTH CONCEPT. Jockey, P.; Bocquet, C.; Durand, F.; Duthoit, G.; Pitiot, C. (CEN de Saclay, Gif-sur-Yvette, France). pp 265-86 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The external count rate observed from radioactively contaminated skin depends on the depth distribution of the contaminating substance. In the case of $\beta-\gamma$ emitters, each situation can be characterized by the activity measured, A, obtained directly by γ spectrometry and the external β count rate, C. The C/A ratio uniquely defines a distribution in the framework of a given hypothesis for the distribution of the radioactivity concentration with depth. Two types of distribution are considered: a plane schematic distribution at a distance d from the skin surface (this distance corresponds to the apparent depth); exponential distributions believed to be close to the real situation. The comparison of the results obtained in calculations on the equivalent dose received by the basal layers of the skin from these two types of hypothesis gives the limit to the validity of the apparent depth concept. The studies were essentially experimental. Results are presented in graphical form for six radionuclides: ^{203}Hg, ^{131}I, ^{137}Cs, ^{198}Au, ^{99}Mo, and ^{24}Na. (France)

17701 METHOD OF DISTINGUISHING EXTERNAL AND INTERNAL CONTAMINATION BY IN VIVO EXAMINATION. Chivot, J. J.; Boulay, P.; Ventadour, J. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). pp 303-16 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The voluntary contamination of six individuals by way of upper air-tracts with a mixture of short-lived radioisotopes, i.e., ^{99m}Tc, ^{133}Xe, and ^{131}I was studied. The doses given amounted to 1/50 of the maximum permissible quantity. The spectra obtained by conventional whole-body gamma dosimetry using a large volume NaI(Tl) detector and a large surface xenon-methane proportional counter are presented. The measurement time was five min. The images are difficult to interpret for low-energy gamma radiation. An excellent resolving power was observed for externally contaminated skin. This resolving power disappears when internal contamination is involved. These types of measurement can be used in conjunction with all fission products emitting low energy electromagnetic radiation. (France)

17702 MORPHOLOGICAL FACTOR IN ESTIMATING THE BODY BURDEN OF INDIVIDUALS CONTAMINATED WITH TRANSURANIC ELEMENTS. Boulay, P.; Chivot, J. J.; Ventadour, J. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). pp 317-36 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

As the confidence factor in the artificial thorax calibration method is very low, another method is proposed for determining individual absorption and diffusion characteristics. This method involves establishing the correlation between the spectrum of an ^{241}Am source absorbed by the rib cage and the morphological characteristics of the individuals (the measurements were made with a xenon filled proportional counter). ^{241}Am is particularly well suited for measurements of this type owing to its abundant 60-keV γ emission (which easily traverses the rib cage) and the escape xenon line associated with certain interactions of the 60-keV γ radiation. It is envisaged that the results obtained from measurements carried out on many individuals could be used to establish a library that could then be consulted when the absorption and scattering characteristics of a given individual were required. A weighting factor can thus be applied in order to calibrate any artificial rib cage as a function of the contaminating radionuclide. (France)

17703 COMPARATIVE FATE OF ESTRONE AND ESTRONE SULFATE IN MAN. Fishman, J.; Hellman, L. (Montefiore Hospital and Medical Center, New York). J. Clin. Endocrinol. Metab.; 36: No. 1, 160-164(Jan 1973).

Estrone-^{14}C and estrone sulfate-^{3}H were simultaneously injected into a 37-yr-old woman and disposition of the two isotopes was followed. The products of estrone sulfate were excreted in urine more rapidly and to a greater extent than those of the coadministered estrone. Estrone was converted to estrone and estradiol glucuronides to a much greater extent than its sulfate conjugate. Estrone sulfate on the other hand contributed more to the urinary estrone and estradiol sulfates. All of the other metabolites irrespective of their conjugation contained equal amounts of both isotopes and were therefore most probably biosynthesized after equilibration of the dose. It is likely that estrone sulfate rather than estrone is the precursor of these compounds. (auth)

Animals

17704 (NP–19629) ANNUAL REPORT, 1971. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (West Germany)). 50p. (In German). Dep. NTIS (U. S. Sales Only).

A longterm experiment was concluded in which four generations of rats received irradiated food. No differences were found between experimental and control groups through teratologic, hematologic, electrophoretic, enzymatic, and histopathologic examinations. Growth, fertility, and litter size, too, failed to indicate any damaging effects of the irradiated diet. (HBG)

17705 TWO-COMPARTMENT MODEL OF RADIONUCLIDE ACCUMULATION INTO MARINE ORGANISMS. Part 1. Accumulation from a Medium of Constant Activity. Ruzic, I. (Institut Rudjer Boskovic, Zagreb). Mar. Biol.; 15: No. 2, 105-112(1972).

The interpretation of kinetics of radionuclide accumulation into biological organisms can be performed by using well-known multicompartment models. The application of a two-compartment model in the interpretation of radionuclide accumulation into marine organisms, when this does not markedly deplete the medium, is considered. Most of the loss experiments cannot be interpreted without the use of uptake data. The agreement between the uptake and loss parameters is discussed. Explicit expressions for different kinds of two-compartment models are evaluated. The interpretation of irreversible and other special cases is proposed. (auth)

17706 BIOLOGICAL BEHAVIOUR OF RADIOINDIUM (^{113m}In, ^{114m}In) IN VIRGIN AND GRAVID RATS. Hor, G.; Kriegel, H.; Schramm, E. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). Int. J. Appl. Radiat. Isotop.; 23: No. 12, 595-602(Dec 1972). (In German).

Distribution studies were carried out in virgin as well as in pregnant rats and the following results achieved: 1. Biological behaviour of carrier free ^{113m}In and of ^{114m}In (containing carrier) varies in dependence on the mode of application and of the amount of carrier, when considering the initial distribution pattern; predominant accumulation of indium several hours later is observed within liver and spleen, independent of the mode of application and of the amount of the carrier. 2. Renal clearance of indium differs after intravenous and subcutaneous injection. 3. Progressive ac-

cumulation of indium within the bone was observed consecutive to i. v. as well as to s. c. injection. 4. Biological behaviour of In within organs of pregnant rats (after i. v. injection) and within organs of virgin rats (after s. c. injection) is comparable: Initially low In concentrations in all the organs were observed and later progressive increase followed. This is shown to be due to initial retention of In within the placental compartment, from which In is gradually freed. Quantitative relations of radioindium content in different organs are calculated. The importance of clinical use of radioindium for placental scintigraphy is discussed. (auth)

17707 EXPERIMENTS IN REMOVING CONTAMINATION OF RADIOACTIVE CESIUM IN THE LIVE ANIMAL. Mirna, A.; Egginger, R. (Bundesanstalt fuer Fleischforschung, Kulmbach, Ger.). Fleischwirtschaft; 52: No. 8, 1018-20(1972). (In German).

The buildup of ^{137}Cs in farm animals is of interest to the veterinarian in view of the resultant radiation effects on the animal and the contamination of food of animal origin (milk, meat, eggs). In a model experiment using laboratory animals (guinea pigs) tests were carried out to see how far the retention of tracer and fallout ^{137}Cs can be influenced by feeding adsorbents such as clay minerals (red Rhaetic clay), Berlin Blue (BB), and colloidal Paris Blue (PB). The clay was found to be less effective than BB and PB. The decontamination effect achieved with all the adsorbents was clearly less in the case of fallout ^{137}Cs than in experiments with radioactive cesium tracer. By giving adsorbents of this kind orally some means, also applicable under practical conditions, can be developed for reducing the risk of contamination for man via food of animal origin. (GF)

17708 EFFECT OF ACTH, HYDROCORTISONE, TESTOSTERONE AND THYROID HORMONE ON THE RETENTION OF ^{46}Sc, ^{60}Co, ^{65}Zn, $^{85\ 89}Sr$ AND ^{144}Ce IN RAT. Szot, Z. (Inst. of Nuclear Research, Warsaw); Geisler, J.; Zylicz, E.; Kloczewiak, M.; Cwik, T. Nukleonika; 17: No. 5-6, 341-50(1972). (In Polish).

Hydrocortisone, ACTH, testosterone, and a thyroid hormone preparation (Thyreoideum-Polfa) were given to male rats for seven successive days and then once a week. On the seventh day of the experiment a single intravenous injection of ^{46}Sc, ^{60}Co, ^{65}Zn, $^{85,89}Sr$, or ^{144}Ce was administered to the animals and the retention of the radioisotope in the body was measured for 30 days with the aid of a whole-body counter. Retention curves were diagramed and retention equations were derived. In the course of the experiment an 11.7 and 8.3% reduction of $^{85,89}Sr$ retention was observed, respectively, in the ACTH and hydrocortisone treated rats as compared with the non-treated controls. Possible mechanisms of the observed effects are discussed. After the ACTH treatment also an about 7% reduction of ^{65}Zn retention was observed in rats. This effect, however, was shown to be due to the solution added to the ACTH preparation by the producer. (auth)

17709 REGULARITIES OF ACCUMULATION OF RADIOISOTOPES IN BIRDS OF THE FOREST BIOCOENOSES. Il'enko, A. I. Zool. Zh.; 49: No. 12, 1884-1886(1970). (In Russian).

The kinetics of ^{137}Cs and ^{90}Sr accumulation in populations of forest birds were studied. Forest regions were artificially polluted with ^{137}Cs (4 to 8 $\mu Ci/m^2$) and ^{90}Sr (1.8 to 3.4 $\mu Ci/m^2$). Relative amounts of radioisotopes in the stomach contents and tissues of birds were determined. The great specific differences in the concentrations of radioisotopes in the bodies of birds were related to an unequal content of radioisotopes in food, depending on the ration composition and place of feeding. Birds feeding on the ground accumulated more radioisotopes than those feeding in trees. Transitions of ^{90}Sr and ^{137}Cs in different links of food chains of phytophagous, insectivorous, and predatory birds are discussed. (Euratom)

17710 DIFFERENCES IN THE CARBON TETRACHLORIDE-INDUCED DAMAGE TO COMPONENTS OF THE SMOOTH AND ROUGH ENDOPLASMIC RETICULUM FROM RAT LIVER. Castro, J. A.; Diaz Gomez, M. I.; de Ferreyra, E. C.; (and others) (CITEFA, Buenos Aires). Biochem. Biophys. Res. Commun.; 50: No. 2, 337-343(23 Jan 1973).

There is a higher activity of ethyl morphine N-demethylase (EM-ase) and cytochrome P-450 (P-450) reductase as well as higher P-450 content in the smooth endoplasmic reticulum (SER) than in the rough endoplasmic reticulum (RER). The extent of the irreversible binding of the ^{14}C from $^{14}CCl_4$ to lipids and proteins, as well as the CCl_4-induced destruction of P-450 is more intense in SER than in RER while the opposite was found for glucose 6-phosphatase (G6P-ase) destruction. CCl_4-induced lipid peroxidation is as intense in SER as is in RER. ^{14}C from $^{14}CCl_4$ gets irreversibly bound to ribosomal proteins. (auth)

17711 MITOCHONDRIAL K^+ TRANSPORT: EFFECT OF N-ETHYL MALEIMIDE ON ^{42}K FLUX. Diwan, J. J. (Rensselaer Polytechnic Inst., Troy, NY). Biochem. Biophys. Res. Commun.; 50: No. 2, 384-391(23 Jan 1973).

The energy-linked flux of K^+ into rat liver mitochondria is stimulated by the sulfhydryl reagent, N-ethyl maleimide. The stimulation of K^+ influx by N-ethyl maleimide is observed only at alkaline external pH. N-ethyl maleimide also stimulates efflux of K^+ from the mitochondria. The stimulation by N-ethyl maleimide of K^+ influx, but not K^+ efflux, is dependent on the availability of metabolic energy. It is suggested that the effect of N-ethyl maleimide on K^+ influx may be secondarily the result of an inhibition of phosphate-hydroxyl exchange. The dependence of energy-linked K^+ influx on the external pH may be interpreted as evidence for a role of OH^- as a counterion accompanying K^+ through the mitochondrial pump mechanism. (auth)

17712 CARBON TETRACHLORIDE ACTIVATION IN LIVER MICROSOMES FROM RATS INDUCED WITH 3-METHYLCHOLANTRENE. Castro, J. A.; de Castro, C. R.; D'Acosta, N.; Diaz Gomez, M. I.; de Ferreyra, E. C. (CITEFA, Buenos Aires). Biochem. Biophys. Res. Commun.; 50: No. 2, 273-279(23 Jan 1973).

The irreversible binding of ^{14}C from $^{14}CCl_4$ to microsomal lipids is decreased in animals treated with 3-methylcholantrene (3-MC), while it is increased in animals induced with phenobarbital (PB). CCl_4-induced lipid peroxidation in 3-MC treated rats is as intense as in controls. Destruction of glucose 6-phosphatase (G6P-ase) by CCl_4 is smaller in 3-MC treated rats than in controls. Destruction of total cytochrome P-450 (P-450 + P_1-450) by CCl_4 is smaller in 3-MC treated than in PB treated rats but similar to that obtained in controls. Results would indicate that P-450 would participate in CCl_4 activation much more effectively than P_1-450. (auth)

17713 EXPERIMENTAL STUDY OF THE BIOLOGICAL AVAILABILITY OF A HEAVY METAL, RUTHENIUM, IN LABORATORY CONDITIONS. Van der Borght, O. (Centre de l'Energie Nucleaire, Mol, Belgium). J. Belge Radiol.; 55: No. 2, 243-252 (1972). (In Dutch).

The fixation of different ruthenium salts by some freshwater and marine animals was studied. Experimental conditions were kept as simple as possible to avoid disturbing influences. The uptake of Ru was quite similar in some freshwater and marine animals, thus indicating that the isotopic dilution of soluble Ru in the marine environment is insufficient to have important physiological consequences on its fixation by these animals. The fixation by organisms and the adsorption on surfaces can differ by an order of magnitude for different salts of ruthenium in freshwater. One salt (Ru nitrosylchloride) was revealed to be toxic by paralyzing the animals. A better knowledge of the physico-chemistry of Ru compounds in dilute neutral solutions is essential to understand the observed facts. The freshwater gastropod fixed ten to hundred times more Ru than the fish used in this study; this points to the usefulness of the former as a biological indicator for the entrance of Ru from the water into the biological cycle. (auth)

Plants

17714 UPTAKE OF ^{90}Sr AND ^{137}Cs BY PLANTS FROM CONTAMINATED SOILS. Grzybowska, D. (Central Radiological Lab., Warsaw). Nukleonika; 17: No. 5-6, 331-40(1972). (In Polish).

In order to investigate the possibility of reducing the uptake of radioactive ^{90}Sr and ^{137}Cs by plants as a result of deep plowing, experiments were conducted in which the contaminating radionuclides were placed in layers at different depths of the soil. Three types of soils were used on which two different plants [grass (Dactylis glomerata) and alfalfa, (Medicago sativa)] were grown, the contamination depths being 0 to 10 cm and 20 to 30 cm. A marked reduction of ^{90}Sr and ^{137}Cs uptake with depth of their placement was observed. Transfer coefficient for soil-plant system for the plants investigated and soil types are given. (auth)

17715 REMOVAL OF CONTAMINATION ON FOODS CAUSED BY FALLOUT. CONCERNING ^{137}Cs ON VEGETABLES. Sasaki, R. (National Inst. of Nutrition, Tokyo). Kokuritsu Eiyo Kenkyusho Kenkyu Hokoku; No. 45, 91-2(Mar 1971). (In Japanese).

Methods of cleaning and removing ^{137}Cs from vegetables contaminated by fallout were compared using several detergents. The cleaning was carefully performed so as not to spoil flavor and appearance. Also consideration was given to cheap cleaning and easy handling by ordinary people. The ^{137}Cs was analyzed by the dipicrylamine-platinum chloride method. A 1% NaCl solution, neutral synthetic detergent solution (0.25% $RC_6H_4SO_3Na$), 0.25% CH_3COOH solution, and tap water were used for the cleaning. As

the result, the neutral detergent solution showed best result of 51.8% reduction on eggplants, as the CH_3COOH solution was not tested lest it should spoil them, while the acetic acid solution was excellent to remove contamination on Spanish paprika pepper, showing 48.1% reduction. This may be due to fact that the ^{137}Cs is soluble in acid solution. But the ^{137}Cs distributed in the flesh of eggplants and cucumbers could not be removed. These results did not differ much from those reported for ^{90}Sr. (Japan)

17716 UDP-GLUCOSE PYROPHOSPHORYLASE SYNTHESIS IN MYXAMOEBAE OF DICTYOSTELIUM DISCOIDEUM. Gustafson, G. L.; Wright, B. E. (Boston Biomedical Research Inst.). Biochem. Biophys. Res. Commun.; 50: No. 2, 438-442(23 Jan 1973).

A mixture of [^{14}C] amino acids and [^{35}S] methionine is rapidly incorporated into the UDP-glucose pyrophosphorylase of amoeboid forms of the cellular slime mold over a period of differentiation in which a significant change in the amount of enzyme does not occur. There is no evidence for a change in the rate of enzyme synthesis prior to or during the initiation of enzyme accumulation. Therefore, there is no evidence for the involvement of specific periods of transcription or translation in controlling the synthesis of this enzyme prior to or during differentiation. (auth)

New Tracer Techniques

Refer also to abstract 17706.

17717 THYROID RADIONUCLIDE UPTAKE MEASUREMENTS. SPECIAL REPORT No. 7. Brit. J. Radiol.; 46: No. 541, 58-63(Jan 1973).

The current status of the thyroid uptake tests are considered. The considerations of the 1970 Expert Panel convened by the IAEA are summarised under the following headings: clinical requirements for uptake tests; early uptake measurement techniques; and late uptake measurement techniques (measurement of ^{131}I uptake after 24 hrs). (UK)

17718 FILTER PAPER ASSAY FOR TRANSAMIDATING ENZYMES USING RADIOACTIVE AMINE SUBSTRATES. Lorand, L.; Campbell-Wilkes, L. K.; Cooperstein, L. (Northwestern Univ., Evanston, IL). Anal. Biochem.; 50: No. 2, 623-31(Dec 1972).

A filter paper assay was developed for measuring the activity of transamidating enzymes by the incorporation of radioactive amine substrates into proteins. The method is analogous to those generally employed for monitoring the enzymic coupling of isotopic groups to proteins, such as in the ATP-dependent phosphorylation of casein or histone. Use of minimal quantities of reagents, as well as simplicity of handling a large number of test samples, are distinct advantages of this technique. (MCG)

17719 METHODOLOGICAL STUDY OF THE RADIOIMMUNOASSAY OF HUMAN THYROTROPHIN. Gordin, A. (Univ. of Helsinki); Saarinen, P. Acta Endocrinol.; 71: 24-36(1972).

An account is given of a methodological study of the double-antibody radioimmunoassay of human TSH, using highly purified labelled human TSH as tracer. It was shown that conventional paper electrophoresis was not adequate for studying the purity of labelled human TSH. When poly(vinyl chloride) (Pevikon) electrophoresis was used, four subfractions could still be separated, even though, on paper electrophoresis, the material seemed to be homogeneous. Only two of the four Pevikon fractions were immunoreactive. Purification of labelled human TSH by Pevikon electrophoresis also improved the sensitivity of the assay. Specific activities of about 100 mCi/mg gave the highest initial binding capacity, produced least damage to the labelled hormone, and showed the best stability of the tracer without influencing the sensitivity of the method. In different storage conditions, labelled human TSH was found to be most stable at −20°C and diluted 1/100. Only in pregnancy did the addition of HCG seem necessary. The mean TSH value in healthy subjects was 3.6 ± 1.4 μU/ml (mean ± SD) with a range from 1.6 to 8.8 μU/ml. (auth)

17720 SOLID PHASE RADIOIMMUNOASSAY FOR THE QUANTITATION OF HUMAN REAGINIC ANTIBODY AGAINST RAGWEED ANTIGEN E. Zeiss, C. R.; Pruzansky, J. J.; Patterson, R.; Roberts, M. (Northwestern Univ., Chicago). J. Immunol.; 110: No. 2, 414–421(Feb 1973).

IgE antibody directed against antigen E (AgE) of ragweed extract was measured quantitatively in the sera of 15 ragweed sensitive patients before initiation of immunotherapy. The assay employed polystyrene tubes successively coated with myeloma IgE and excess rabbit anti-IgE. This matrix, which was specific for IgE, bound IgE for the patients' serum in a reproducible and measurable manner. Radiolabeled AgE then reacted quantitatively with IgE antibody from the patients' serum, which was attached to the solid phase. A double antibody method was developed simultaneously and gave comparable results for sera assayed by both procedures. Total serum IgE and the dose response of histamine release by AgE from washed leukocytes of the patients were also determined. The concentration of IgE anti-AgE in the 15 sera ranged from 3.2 to 400 ng/ml by polystyrene tube assay. Serum IgE ranged from 82 ng to 6 μg/ml and the percentage of the serum IgE specific for AgE varied from 0.3 to 41. Leukocyte sensitivity measured by the reciprocal of the minimum concentration of AgE resulting in release of 50% of the total histamine encompassed a 300-fold range. The level of IgE antibody to AgE was not correlated significantly with total serum IgE. Cell sensitivity varied independently of total serum IgE or nonspecific IgE. A highly significant correlation was found between IgE anti-AgE and cell sensitivity. Leukocyte sensitivity was found to be an exponential function of the serum antibody concentration. (auth)

17721 UTILIZATION OF SODIUM PYROPHOSPHATE LABELLED WITH ^{99m}Tc IN SKELETON SCINTISCANNING. Cohen, Y.; Perez, R.; Henry, R.; Bardy, A.; Panneciere, C. (CEN de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. D; 275: No. 15, 1719-1721(9 Oct 1972). (In French).

Sodium tin technetium pyrophosphate complex is fixed by bone cells. The degree of fixing varies with the metabolic activity of the cell. The bone tissue retains the radioactive tracer (^{99m}Tc) and lesions can be detected using scintiscanning. Experiments were performed with rats. The distribution of ^{99m}Tc after intravenous injection, the elimination of the complex from the blood, and the urinary excretion were studied. (France)

17722 TEMPORAL PATTERNS OF CIRCULATING HORMONES AS ASSESSED BY CONTINUOUS BLOOD SAMPLING. Alford, F. P.; Baker, H. W. G.; Patel, Y. C.; (and others) (Monash Univ., Clayton, Australia). J. Clin. Endocrinol. Metab.; 36: No. 1, 108-116(Jan 1973).

Definition of rhythms and mean daily levels of GH, TSH, LH, FSH, and testosterone was obtained by a continuous blood sampling technique using a double lumen catheter and measurement of integrated plasma levels by sensitive and precise radioligand assays in 9 healthy young adults (7 males and 2 females). In each subject, sequential continuous blood samples of 3 to 4 hr duration were obtained over a 24-hr period of near normal activity. Growth hormone rises in samples coincident with sleep onset in the males, a circadian rhythm of TSH levels (peak at midnight, nadir in the afternoon) and no significant time related changes of LH and FSH levels in the whole group or of testosterone in the males were found. (auth)

17723 SIMPLIFIED RADIOIMMUNOASSAY FOR TRIIODOTHYRONINE. Patel, Y. C.; Burger, H. G. (Monash Univ., Clayton, Australia). J. Clin. Endocrinol. Metab.; 36: No. 1, 187-190(Jan 1973).

A highly sensitive radioimmunoassay (RIA) for T_3 was developed in which ethanol extracts of serum are incubated with antiserum and tracer in order to minimize serum protein interference. Recovery by this method was complete and reproducible. Assay sensitivity ranged from 6 to 14 ng/100 ml. Mean serum T_3 concentrations (ng/100 ml) in normal and abnormal thyroid states were as follows: 130 (normal males); 127 (normal females); 172 (normal females on oestrogens); 450 (hyperthyroidism); 42 (severe primary hypothyroidism; 127 (borderline primary hypothyroidism); 38 (secondary hypothyroidism). This procedure is suitable for routine clinical use and has the potential for simultaneous T_3 and T_4 measurements. (auth)

17724 INVESTIGATION OF A RADIOIMMUNOASSAY FOR PLASMA ESTRONE AND ESTRADIOL-17β IN MALES AND NONPREGNANT FEMALES. Comparison with an Independent Method Using Fluorimetry. Wright, K.; Robinson, H.; Collins, D. C.; Preedy, J. R. K. (Emory Univ., Atlanta). J. Clin. Endocrinol. Metab.; 36: No. 1, 165-173(Jan 1973).

A radioimmunoassay for estrone and estradiol-17β in plasma from males and non-pregnant females similar to those used by other workers was investigated. Chromatography using Sephadex LH-20 separated estrone from estradiol-17β, but neither was separated from other naturally-occurring estrogens. Cross-reactions with the antiserum were found for several of these estrogens in both estrone and estradiol-17β assay systems, thus indicating the possibility of substantial interference in the assays. This possibility was investigated. The material measured as plasma estrone and estradiol-17β by radioimmunoassay was subjected to a number of identification procedures and found to have the characteristics of estrone and estradiol-17β. Comparison of plasma estrone and estradiol-17β levels obtained by radioimmunoassay and by a fluorescence procedure which excludes

measurement of the other estrogens mentioned above yielded a regression coefficient and intercept not significantly different from 1 and 0, respectively, for both estrone and estradiol-17β determinations. It was concluded that, although the potential for interference remains, other naturally-occurring estrogens do not contribute significantly to the radioimmunoassay values for plasma estrone and estradiol-17β in normal males and nonpregnant females. (auth)

MATERIALS

17725 (IA–1262) RESEARCH LABORATORIES ANNUAL REPORT, JANUARY–DECEMBER 1971. (Israel Atomic Energy Commission, Tel Aviv). Aug 1972. 224p. Dep. NTIS (U.S. Sales Only).

Summaries of research are presented on mathematics, theoretical physics, theoretical chemistry, neutron physics, reactor physics, solid state physics, metallurgy, nuclear physics, radiation chemistry, inorganic chemistry, analytical chemistry, tracer techniques, health physics, biology, medicine, nuclear safety, instrumentation, vacuum technology, radioisotopes, and labelled compounds. (JRD)

Ceramics and Cermets

Refer also to abstracts 17165, 17181, 17471, 17493, 17854, 17868, 17873, 17883, 17892, 18608, 19020, 19072, 19102, 19106, and 19246.

17726 (AERE-R-6911) LABORATORY DETERMINATIONS OF STRONTIUM DIFFUSION COEFFICIENTS IN GRAPHITE. Sandalls, F. J.; Walford, M. R. (Atomic Energy Research Establishment, Harwell (England)). Jan 1972. 19p. Dep. NTIS (U. S. Sales Only).

Diffusion coefficients for carrier-free strontium-85 in two types of reactor-grade graphite and two types of bonded compacted graphite were determined in the temperature range 1200 to 1600°C. In all four cases the activation energy was found to lie in the range 68 to 79 kcal/mole, and the diffusion coefficients found to fall within a factor of ten of each other. The diffusion rate of strontium in a reactor-grade graphite which had been previously loaded with stable strontium was also studied, and it was found that quite small amounts of strontium previously diffused into the graphite can greatly influence the diffusion rate of strontium subsequently entering the graphite. At 1000°C, a concentration of 2 mg/g graphite increases the diffusion coefficient by some 5 orders of magnitude. The diffusion coefficients quoted are considered to be suitable for use in predicting the long-term movement of strontium through fuel-tube walls in a High Temperature Gas-Cooled Reactor (HTGR) where the graphite is similar to the graphites used in this work. (auth)

17727 (BNWL-tr-80) PHYSICAL-CHEMICAL STATE OF FISSION PRODUCTS IN IRRADIATED $(U,Pu)O_2$ FUELS. Camoszzo, G. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Translated by E. R. Appleby (Battelle Pacific Northwest Labs., Richland, Wash.), from report EUR-4613. 36p. Dep. NTIS.

A bibliographic review of the knowledge concerning the physical-chemical state of fission products in uranium oxide and mixed uranium–plutonium oxide fuels after irradiation is presented for the purpose of predicting and understanding the reactions that may occur when an irradiated fuel element is subjected to decladding by molten metals or treated by molten salts. Other aspects of the irradiated fuel such as structure, distribution of plutonium, and reduction of the uranium are considered in order to give an overall picture that may complete the main subject. Special attention is given to results concerning mixed oxide fuels with high burnup for fast reactors, but because of the insufficiency of data in this field, the uranium oxide fuels are also examined with the purpose of a qualitative first approximation for a more specially detailed and specific study relating to fast reactor fuels operated to high burnup. (auth)

17728 (GULF-GA-B-12238) SiC CORROSION IN TRISO I COATED $(Th,U)O_2$ PARTICLES. Stansfield, O. M. (Gulf General Atomic Co., San Diego, Calif.). 29 Sep 1972. Contract AT(04-3)-167. 40p. Dep. NTIS.

Heating unirradiated TRISO I coated $(Th,U)O_2$ particles isothermally or in a thermal gradient at temperatures of 1400 to 1700°C and for times from 200 to 15,500 hr caused no significant fuel dispersion from the kernel or unilateral kernel migration (amoeba effect). No carbon or UC_2 was detected in the kernel after heating. During thermal gradient heating, corrosion of the SiC coating was observed on the hot side of the SiC adjacent to the buffer in about 15% of the particles examined. At 1400 to 1500°C and under thermal gradients of 300 to 1400°C/cm, corrosion rates of 0.4 to 5.5 $\times 10^{-14}$ g Si/sec were commonly observed. Although the presence of a thermal gradient was necessary for the corrosion mechanism to operate, the large scatter in experimental data masked the dependence of corrosion rate upon thermal gradient. The temperature dependence of SiC corrosion was also masked by scatter in the data, which was not inconsistent with the low-temperature dependence expected in gas transport mechanisms. The most probable corrosion mechanism is one involving the formation and transport of SiO gas from the hot to the cool side of the particle. Further work on both irradiated and unirradiated oxide particles is desirable to more accurately define the temperature dependence and the effect of fission-product inventory on SiC corrosion in particles with SiC exposed to gases in the buffer. However, until results from such work are available, the results reported can be used to provide a first approximation of corrosion rates in irradiated TRISO II coated fissile-oxide particles that have experienced failure of the protective inner pyrolytic carbon coating. (auth)

17729 (LA-5106) ADVANCED PLUTONIUM FUELS PROGRAM. Quarterly Progress Report, July 1–September 30, 1972. Baker, R. D. (comp.) (Los Alamos Scientific Lab., N. Mex.). Nov 1972. Contract W-7405-eng-36. 26p. Dep. NTIS.

Research and development directed toward examination and comparison of the effects of neutron irradiation on LMFBR fuel materials are summarized. Research results are also included on advanced LMFBR fuel materials and on analytical methods required for characterization of fuels, control rod materials, and measurement of burnup. (JRD)

17730 (ORO-4212-13) QUANTITATIVE DETERMINATION OF THE STRUCTURE–PROPERTY RELATIONSHIPS IN NUCLEAR FUEL ELEMENT MATERIALS. Quarterly progress report, July 1–September 30, 1972. Rhines, F. N.; DeHoff, R. T.; Whitney, E. D. (Florida Univ., Gainesville. Engineering and Industrial Experiment Station). Dec 1972. Contract AT(40-1)-4212. 80p. Dep. NTIS.

An empirical relationship between gas permeability and microstructure was evolved for UO_2 sinterings and compared with that for Ni sinterings. New creep curves for Ni sinterings of varying structures and creep conditions were determined. Quantitative microscopy of all these samples was completed and the effect of creep on the pore structure assessed. The path of microstructural change during hot pressing and cold-press–fire treatments was determined by preparing and analyzing UO_2 samples. These samples were subjected to the diametral load test and the tensile strength evaluated and correlated with structure. (DLC)

17731 (TID-16315) ADVANCED NUCLEAR ROCKET MATERIALS RESEARCH. Whitman, M. J. (Division of Reactor Development (AEC), Washington, D. C.). Aug 1962. 8p. Dep. NTIS.

Declassified 19 Oct 1971.

Properties of materials selected for research associated with their development and use in high temperature nuclear rockets are discussed. Metals of interest are listed and discussed along with graphite, carbides, sulfides, nitrides, oxides, and borides. (JRD)

17732 (TIM-770(Suppl. 4)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-173. Carlson, C. E.; Felber, F. F. Jr. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 20 Oct 1964. 16p. Dep. NTIS.

Declassified 21 Oct 1971.

The irradiation behavior of hyperstoichiometric UC fuel in unlined Nb–1 Zr alloy tubing was conducted for 2283 hours at 2217°F (middle pin clad temperature) to a burnup of 1.4 at.% uranium fission. The following are the results of the postirradiation examination. The top specimen failed, but the middle and bottom specimens remained gas tight. Diametral increases of the latter two specimens were 2.0% and 2.3%, respectively. The respective pin pressures were 24.8 and 23.3 psia. Failure of the top pin was attributed to the presence of localized areas of high ^{235}U content near the surface of the top fuel pellet. These areas were also observed randomly in all fuel pins. There was a continuous carbide layer on the ID of all cladding, and carbon had diffused across the clad wall. The initially hyperstoichiometric fuel was predominantly UC phase, with a small amount of U_2C_3. The fuel porosity was high (density decreased by 10.4 to 14.1%), and concentrated in the grain boundaries. Fission gas release was 12.9 to 13.1%. Burnup and power densities were 1.44 at.% uranium fission, and 1.75 kW/cm^3. (auth)

17733 (TM-64-6-34) IRRADIATION OF 6 CERAMIC FUEL TUBES IDENTICAL TO LTC-70, BUT COATED WITH YTTRIUM STABILIZED ZIRCONIA ONE MIL THICK ON INSIDE AND OUT-

SIDE DIAMETERS. Blevins, R. E. (Oak Ridge National Lab., Tenn.). 18 Jun 1964. AT(40-1)-2847. 15p. Dep. NTIS.

Declassified 5 Nov 1971.

The LTC-71 specimens comprise UO_2 particles coated with BeO, held in a BeO matrix, and coated with Y-stabilized ZrO_2 on both sides of the hexagonal tubes. The specimens were irradiated for 3 weeks in the LITR. A brief account is given of the reactor operating history, and results are reported of the postirradiation examination and rare-gas trap analyses. (DLC)

17734 (TM-66-3-3) THERMAL CYCLIC TESTING AND EVALUATION OF Ta-ENCAPSULATED UO_2 AND UO_{2-x} IN HELIUM ATMOSPHERES FROM 3900° TO 500°F. Korton, G. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation.). 1 Mar 1966. Contract AT(40-1)-2847. 37p. Dep. NTIS.

Declassified 4 Nov 1971.

Stoichiometric and substoichiometric urania pellets encapsulated in Ta, Ta–10W, and Ta overclad with Re were thermal cyclic tested from 500 to 3900°F in static He atmospheres. Some capsules were tested in the "as-sealed" condition containing from six to eleven percent void volume while others were autoclaved to eliminate the void volume prior to testing. Dimensional, volumetric, hardness, and weight measurements in addition to helium leak and ultrasonic bond checks were made at various intervals during testing. After testing, the capsules were sectioned for metallographic analysis of clad and urania and the O/U ratios of the urania pellets were determined by ignition. Results showed that in both autoclaved and nonautoclaved Ta or Ta–10W capsules, urania equilibration with the external helium atmosphere occurred to an extent not significantly different from that previously observed in isothermal testing similar capsules in argon atmospheres. Evidence of interaction of Ta and Ta–10W clads with free uranium was observed in both autoclaved and nonautoclaved capsules, the extent of reaction being significantly greater in those capsules containing substoichiometric urania prior to test. In Re overclad capsules, oxygen diffusion from the urania to the Ta was observed in addition to clad-free uranium interaction. However, the two mechanisms, oxygen and uranium diffusion, appeared to balance one another such that no reduction in urania stoichiometry occurred. Approximately half of the capsules tested developed clad leaks which appeared to be related to three factors: the extent of interstitial clad hardening, thermal stresses induced in thermal cycling, and the formation of UO_2 grain-boundary precipitates in the clad. With continued cyclic testing the encapsulated urania pellets increased in density while significant increases in total capsule volume were observed. The formation of vapor species resulting in a gas pressure appeared to be the most logical explanation of this phenomenon. (auth)

17735 (TM-66-4-700) SAMPLE GEFP 2-7: SUMMARY OF RESULTS OF IRRADIATION IN ETR. Urban, F. O. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation.). 31 Mar 1966. 7p. Dep. NTIS.

Declassified 4 Nov 1971.

Results of irradiation testing of clad fuel specimen GEFP 2-7 through cycle 77 of the ETR are reported. Data are included on heat generation rates and total fissions, temperature spread in the sample, exposure time and temperature, sudden temperature reduction, and fission trap operation. (JRD)

17736 (TM-66-5-7) RELEASE OF OXYGEN THRU NUCLEAR DAMAGE TO THE BeO MOLECULE IN A REAR SHIELD. Messingschlager, J.M. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation.). 4 May 1966. Contract AT(40-1)-2847. 4p. Dep. NTIS. Declassified 4 Nov 1971.

Results of work conducted to measure the oxygen release from BeO molecules by (n, α) and (n, 2n) reactions with Be are reported. It was concluded that the quantity of oxygen produced by these reactions is too small to cause corrosion of the shielding. (JRD)

17737 (TM-66-6-703) SAMPLE GEFP 2-8: SUMMARY OF RESULTS OF IRRADIATION IN ETR. Urban, F. O. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation.). 14 Jun 1966. 10p. Dep. NTIS.

Declassified 4 Nov 1971.

Results are presented of irradiation testing of clad fuel specimen GEFP 2-8 through cycle 79 of the ETR. Data are included on specimen heat generation rates, fissions, burnup, exposure time and temperature, thermal shocks, and fission gas trap operation. (JRD)

17738 EFFECTS OF ADDITIVES ON SINTERING. Halbfinger, G. P. (Pennsylvania State Univ., University Park). Int. J. Powder Met.; 8: No. 4, 231-3(Oct 1972).

Models of diffusion processes occurring during compact sintering are analyzed. It is noted that sintering materials are rarely homogeneous and that, in order to further the understanding of diffusion mechanisms, a comparison must be made of the diffusivities of the host material and of the bulk diffusivity of the material in the additive. If the additive does not evenly coat the host material, there is no way of accurately predicting the value of the latter. It is felt that impurity concentrations cannot always be neglected, and may play a dominant role in ThO_2–2.5 at. % NiO sintering. (JRD)

17739 EFFECT OF REACTOR IRRADIATION ON THE STRUCTURE OF Al–Al_2O_3–Al AND Al–SiO_x–Al. Podleptskii, B. I.; Patrikeev, L. N.; Roizin, N. M. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 99-101(1972). (In Russian).

The effect of reactor radiation on films of Al_2O_3 and SiO_x was studied by irradiating thin-film structures of Al/Al_2O_3/Al and Al/SiO_x/Al on a pyroceramic support in a nuclear reactor. The specimens were thus exposed to a broad spectrum of neutrons accompanied by γ radiation. The dielectric constant of both types of film remained practically unchanged. The static volt–ampere characteristic of Al_2O_3 was altered by radiation considerably more than that of SiO_x. The percentage of failures (breakdowns) was studied as a function of the integral dose of radiation; failures on the part of Al_2O_3 samples were fewer than those of SiO_x films. (KSW)

17740 STUDY OF THE PHASE COMPOSITION AND PROPERTIES OF PERICLASE-ZIRCONIA AND SPINEL-ZIRCONIA REFRACTORIES. Strakhov, V. I.; Klyucharov, Ya. V.; Sergeev, G. G. (Leningrad Inst. of Tech.). Refractories (USSR) (Engl. Transl.); 13: No. 3-4, 260-263(1972).

Translated from Ogneupory; 13: No. 4, 48-52(Apr 1972).

Results of investigations are presented which show that Nd_2O_3 and MgO do not react at temperatures of up to 1600°C. ZrO_2, stabilized with 12% (mole) Nd_2O_3, forms with the MgO a cubic solid solution with limited solubility of periclase: the concentrations in this solid solution of magnesia at 1750° reach 12 to 13% (mole). It is confirmed that an addition of Nd_2O_3 increases the resistance to decomposition of cubic solid solutions ZrO_2–MgO. With an increase in temperature and in the presence of Nd_2O_3 there is rapid decomposition of $MgAl_2O_4$, as a result of which neodymium monoaluminate and periclase are formed. The neodymium oxide forming with the ZrO_2 a cubic solid solution does not react with the spinel. A solubility of 1.5 to 2% for ZrO_2 in $MgAl_2O_4$ is noted. Studies were made of some properties of periclase–zircon and spinel–zircon refractories. The composition ZrO_2–$MgAl_2O_4$ is better in terms of thermal-shock resistance than products made from MgO and ZrO_2, stabilized with Nd_2O_3. (auth)

17741 PLAN FOR IRRADIATION TESTING OF FUEL CONTAINING Gd_2O_3 FOR LIGHT-WATER POWER REACTORS. Yamamoto, T. (First Atomic Power Industry Group, Tokyo); Furuta, T. FAPIG (Tokyo); No. 65, 34-7(May 1972). (In Japanese).

Plans for irradiation test of fuel containing Gd_2O_3 as burnable poison are described. Design parameters and structure of a fuel test assembly (FTA) are described. Nuclear characteristics of the FTA are to be tested in the TCA critical assembly to establish correctness of design. Physical and metallurgical properties of UO_2 containing Gd_2O_3 are also to be measured. The FTA is also to be tested hydrodynamically. The FTA is then to be loaded in the core of JPDR-II to test irradiation behavior. After the irradiation, the FTA is to be examined by several methods. (Japan)

17742 METHOD OF PREPARATION OF ACTINIDE NITRIDES. Triggiani, L. V. (to Grace (W. R.) and Co.). German Patent 1,667,522. 16 Mar 1972. 38p. (In German).

The invention concerns a process for the preparation of one or more nitrides, oxynitrides, carbonitrides, or carboxynitrides of an actinide metal. This is characterized in that (a) the metal oxide in colloidal form in the presence of colloidal carbon and (b) a carbide of the metal obtained by heating the metal oxide in colloidal form in inert atmosphere with carbon, are heated in a nitrogen atmosphere. The prepared fuel microspheres are coated with pyrolytic carbon by methane pyrolysis. (GF)

17743 METHOD FOR THE PREPARATION OF MULTICOMPONENT NUCLEAR FUELS. Triggiani, L. V.; Sanchez, M. G. (to Grace (W. R.) and Co.). German Patent 1,771,966. 1972. 24p. (In German).

The patent claims relate to a procedure for the preparation of nuclear fuels consisting of oxides of at least two metals of the actinides, characterized in that a fertile material in the form of microspheres is brought together with a fissionable material

either in liquid or gaseous phase in order to impregnate the microspheres with the fissionable material which is then converted into an insoluble state. (GF)

17744 MECHANICAL PROPERTIES OF BORON(II) FIBERS. Cueilleron, J.; Roux, Y. (Lyon Univ., Villeurbanne, France). Ann. Chim. (Paris); 7: No. 4, 235-241(Jul 1972). (In French).

The dependence of the mechanical properties of boron fibers on the principal parameters defining the reaction conditions (temperature, composition of the gaseous mixture, time spent by the filament in the chambers) is discussed. The characteristics of the behavior of the boron filament during tensile strength tests are presented: elastic deformation and dispersion of the tensile-strength values. Tensile-strength values for filaments prepared in a single deposition chamber are compared with those of filaments prepared successively in two, three, or four chambers. The relation between the mechanical properties and the microstructure of the fibers was studied: nature and composition of the crystalline phases; extent of the amorphous region; boride–boron interfaces. A certain number of faults in the bulk of the fibers and at their surfaces were detected. (France)

17745 PREPARATION OF CRYSTALLINE REFRACTORY CARBIDES BY ZONE MELTING. Packer, M. E.; Murray, M. J. (Univ., Cambridge, Eng.). J. Cryst. Growth; 16: No. 3, 240-248 (Dec 1972).

Radio-frequency heating employing an eddy current concentrator was used to grow well-characterised samples of cubic transition metal carbides (TiC, ZrC, VC, NbC, TaC) by the floating zone method. An inert atmosphere at atmospheric pressure was used to suppress evaporation. The paper describes the quality of the crystalline materials produced by this means and discusses the growth characteristics which prevail under these conditions. Particular attention is paid to molten zone stability, stoichiometry, conditions for the growth of single crystals, and difficulties encountered in the use of seed crystals to grow crystals of particular orientation. (auth)

17746 SOLID STATE CHEMISTRY. Proceedings of the 5th Materials Research Symposium Held at Gaithersburg, Maryland, October 18–21, 1971. Roth, R. S.; Schneider, S. J. Jr. (eds.). National Bureau of Standards Special Publication 364. Washington, DC; National Bureau of Standards (1972). 799p. (NBS-SPEC.-PUBL-364; CONF-711019). GPO $7.50.

Sixty-three articles are included; a separate abstract was prepared for each of 21. For four of the papers only abstracts were included. Two of the papers contain information on oxygen dissociation pressures and phase behavior in the transplutonium oxides and binary solid solutions of PaO_2 and other actinide dioxides and their exchange equilibria with molten salt reactor fluorides. The remaining 36 papers contain information on oxides, chalcogenides, and nonstoichiometry. Two papers appeared previously in NSA; see NSA 26: 954 and 6412. (PCH)

For abstracts of individual papers see: 17747–17766, and 19020.

17747 SOME ASPECTS OF THE INVESTIGATION OF INTERGROWTH PHASES IN Nb_2O_5-RICH SYSTEMS. Gruehn, R. (Justus Liebig Univ., Giessen, Ger.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 63-86(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Numerous Nb_2O_5-rich compounds with complicated compositions could be prepared as monophasic samples. The preparative and analytical work in this field was supplemented by x-ray investigations using the Guinier technique. In addition to 5 phases ($Nb_{11}O_{27}$, $Nb_{25}O_{62}$, $Nb_{28}O_{70}$, $Nb_{31}O_{77}F$, $Nb_{34}O_{84}F_2$) whose structures are known from investigations by Wadsley, Andersson, and Norin, four "hybrid" phases also called intergrowth-phases were found. The building principle of the hybrid phases $NbO_{2.464}$, $NbO_{2.483}$, $Nb(O,F)_{2.510}$, and $Nb(O,F)_{2.523}$ is a combination of building elements of both neighbor phases, e.g., $NbO_{2.483}$ combines component rows of the $Nb_{25}O_{62}$ structure and the $Nb_{28}O_{70}$ structure in a ratio 1:1. It is of special interest that the phases $Nb_{25}O_{62}$, $Nb_{28}O_{70}$, $Nb_{31}O_{77}F$, and $Nb_{34}O_{84}F_2$ have small but exactly reproducible ranges of homogeneity. The fundamental reason for this deviation from the ideal composition is still unknown. It may be that the deviation from the ideal composition is due to the special properties of the building elements. According to this the nonideal composition of a hybrid phase may be derived from the nonideal composition of both neighbor phases, e.g., the actual composition $NbO_{2.483\pm0.001}$ of the hybrid phase may be calculated from the actual limits of the phases $Nb_{25}O_{62}$ (2.478 O/Nb) and $Nb_{28}O_{70}$ (2.489 O/Nb). A hybrid phase with the ideal composition 2.491 O/Nb ($Nb_{25}O_{62}$ + $Nb_{28}O_{70}$) is nonexisting. In addition to the combination of compositions of neighbor phases there may be a relationship between the stabilities of the basic structures and the resulting hybrid phases. (auth)

17748 APPLICATION OF ELECTRON OPTICAL TECHNIQUES TO HIGH-TEMPERATURE MATERIALS. Allpress, J. G. (Commonwealth Scientific and Industrial Research Organization, Melbourne). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 87-111(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Careful studies of phase equilibria in many high-temperature systems have revealed unexpectedly complex structural relationships, which are frequently very difficult to understand by means of conventional x-ray techniques. Studies were made on how and why the electron microscope can be used to advantage in these circumstances. The value of the technique will be demonstrated by referring to the following recent applications in the field of the structural chemistry of oxides: the determination of unit cell data for microcrystalline samples of alkali metal rare earth titanates, using electron diffraction; the use of dark field microscopy to study the precipitation of the ferrimagnetic spinel $LiFe_5O_8$ from a nonstoichiometric matrix of α-$LiFeO_2$ in which the morphology of the precipitate depends critically upon prior thermal treatment; the direct observation of crystallographic shear planes in WO_{3-x} ($x < 0.05$) and $WO_3 \cdot yNb_2O_5$ ($y = 0.03-0.09$) in which the results show how changes of composition are accommodated in these systems, and provide clues as to the mode of formation and diffusion of crystallographic shear defects; the study of regions of solid solution in the system $TiO_2-Nb_2O_5$ (>50 mole % Nb_2O_5), by lattice imaging in which variations in composition are accommodated by coherent intergrowth, at the unit cell level, of thin slabs of several parent phases; and the study of phases in the system $WO_3-Nb_2O_5$ which have structures related to that of tetragonal tungsten bronze. Several different superlattices are possible, and lattice images provide direct evidence for order-disorder, microdomain formation, and intergrowth with material having a much simpler cubic structure. (auth)

17749 STRUCTURE AND INTERGROWTH OF THE POLYMORPHIC FORMS OF $ZrO_2.16Nb_2O_5$. Stephenson, N. C.; Beale, J. P.; Craig, D. C. (Univ. of New South Wales, Kensington, Australia). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 165-82(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

The compound $ZrO_2 \cdot 12Nb_2O_5$ has been reported to exist in three polymorphic forms, one of which is isostructural with $TiNb_{24}O_{62}$. The crystal structures of the remaining two polymorphs have been determined by examining x-ray data collected from a single crystal of the β-monoclinic form. The unit-cell dimensions are a = 39.693, b = 3.830, c = 35.488 Å, β = 116.53°. 2948 data were collected using a single-crystal diffractometer and Cu$K\alpha$ radiation. No assumptions were made about the structural features and the basic subcell unit was deduced from the Patterson function. Modifications of this subcell give rise to the remaining two polymorphs, which contain blocks of 3 × 3, 4 × 4, and 3 × 4 corner sharing octahedra. The 3 × 4 blocks are all at the one level and form sheets running parallel to (100). The 3 × 3 and 4 × 4 blocks form sheets which alternate with those just described. The manner in which the sheets fit together determines which polymorph is formed. Although the structures were solved using standard x-ray procedures, the solutions were facilitated by using features of electron-transmission micrographs. These consisted of a regular array of dots and streaks (plane group p2) arranged in lines parallel to c. The spatial distribution and contrast of these dots and streaks, together with their arrangements at antiphase boundaries and fault areas, impose certain restrictions upon structures that can be derived by modifications of the basic subcell. In terms of structure, the areas of contrast on transmission micrographs can be identified with the different types of block junctions. (auth)

17750 SUPERSTRUCTURE OF THE ORTHORHOMBIC Nb_2O_5.$6ZrO_2$ TYPE PHASE(S) IN THE $Nb_2O_5-ZrO_2$ AND $Ta_2O_5-ZrO_2$ SYSTEMS. Roth, R. S.; Waring, J. L.; Brower, W. S.; Parker, H. S. (National Bureau of Standards, Washington, DC). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 183-96(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

The phase previously described as $Nb_2O_5 \cdot 6ZrO_2$ has been found to have a composition varying from a $Nb_2O_5:ZrO_2$ ratio of about 2:9 to 2:15. The solidus temperatures of the intermediate compositions studied seem to follow a smooth curve from 1435 to

1640°C rather than a stepwise function expected from a series of compounds. The x-ray-diffraction powder patterns indicate a series of phases with subcells similar to α-PbO_2 and orthorhombic symmetry. Superstructure lines indicate that these phases have a multiple b axis. The composition 2:9 corresponds approximately to a structure with a b-axis multiplicity of seven. The 2:11 composition appears to have a multiplicity of eight, 2:13 a multiplicity of nine and the last composition 2:15, a multiplicity of ten. The intermediate compositions 1:5, 1:6, and 1:7 show superstructure lines halfway between those of the simpler phases on either side, corresponding to multiplicities of 15, 17, and 19, respectively. These multiplicities and compositions thus appear to belong to a homologous series $M_{n-1}O_{2n}$ where n varies from 14 to 20. However the phase equilibria data do not rule out the possibility of a homologous series M_nO_{2n+1}. Compositions in the $Ta_2O_5-ZrO_2$ system apparently have the same composition vs multiplicity arrangement, however, their melting points are considerably higher. Single crystals of these phases, prepared by both direct cooling of a melt and utilization of a barium vanadium oxide eutectic flux, have enabled the multiplicities to be completely verified and are now being used for crystal structure determinations. This stabilization of the high pressure form of ZrO_2 (the orthorhombic structure type) by means of higher valence cations provides an alternate process to the anion deficient stabilization of the cubic fluorite phase. (auth)

17751 STRUCTURES AND CHEMICAL BOND PROBLEMS IN VANADIUM OXIDES. Hagenmuller, P. (CNRS, Talence, France). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 205-18(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

A study of the magnetic and electrical properties of the phase $K_{2-x}V_{3+2x}O_{8+2x+\epsilon}$ ϕ in the system $V_2O_5-VO_2-K_2O$ showed that it can be written formally as $K_{2-x}V^{4+}V^{5+}_{2-3x+2\epsilon}(V^{4+}_{3x+2\epsilon})_{subst.}(V^{4+}_{2x})_{ins.}O_8(O_{2x+\epsilon})_{ins.}$ $K_2V_3O_8$ is actually an insulator in which the V^{5+} and V^{4+} ions occupy well-defined sites $(K_2V^{4+}(V^{5+})_2O_8)$. It does not become a conductor until the progressive appearance of d-electrons in the V^{5+} sites as a result of a hopping mechanism. The variation with x of the Curie constant shows that the vanadium, inserted in the form of chain links (O)-V-O-V-(O) in the tunnels emptied by the potassium, also occupies a particular site. These properties were confirmed by the determination of the structure: the phase ϕ, which is isostructural with $Ba_2TiSi_2O_8$, is actually made up of three types of cationic sites. VO_2 has an allotropic transformation at 340°K of the type homopolar bonding⇌metal. This transformation is characterized by a change of symmetry from monoclinic to tetragonal of the rutile type. The replacement of vanadium 4+ by cationic substitution of the type $2V^{4+} = M^{5+}(Nb^{5+}f.e.) + V^{3+}$ or by anionic substitution $V^{4+} + O^{2-} = V^{3+} + F^-$ results in the lowering of the transition temperature. It seems to be the result of the progressive occupancy of a π band. On the other hand the transformation temperature is raised by a substitution of the type $2V^{4+} = M^{3+}(Cr^{3+}f.e.) + V^{5+}$, and there appears an intermediate semiconducting phase of orthorhombic symmetry. The existence of this phase can be explained by the ferroelectric distortions due to vanadium 5+. The charge of the physical properties with the substitution rate is analyzed on the basis of the obtained structures. The phase $La_{1-x}Sr_xVO_3$ ($0 \le x \le 0.40$) with a structure derived from $GdFeO_3$ is characterized by an evolution from semiconductor to metal with increasing x. This latter results from the strengthening of the π(B-O) bond which is a consequence of the weakening of the σ(A-O) bond and the partial replacement of vanadium 3+ by vanadium 4+. This change is less sensitive for the phase $Gd_{1-x}Sr_xVO_3$, Gd^{3+} being more acidic than La^{3+} and hence σ(A-O) stronger and π(B-O) weaker. The results are compared with those obtained for the homologous $LnTO_3$ phases, Ln being a lanthanide and T a 3d-transition element, on the basis of Goodenough's covalent mixing parameters λ_π and λ_σ. The influence of various factors on the physical properties is discussed. (auth)

17752 GROWTH AND X-RAY STUDIES OF SINGLE CRYSTALS OF HIGHER OXIDES OF PRASEODYMIUM AND TERBIUM. Lowenstein, M. Z.; Kihlborg, L.; Lau, K. H.; Haschke, J. M.; Eyring, L. (Arizona State Univ., Tempe). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 343-51(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Single crystals of higher oxides of Pr and Tb were grown using hydrothermal techniques. Cold-seal reactors were used to study the crystallization process at 600 to 900°C and pressures up to 3.1 kbar. Crystal-growth conditions were optimized using controlled pressure and temperature cycling. Nitric acid served both as a mineralizer to promote solubility and as a source of oxygen. Two predominant crystal habits are observed; octahedra and trigonal prisms. Faces are smooth and well-defined. Single crystals of PrO_2 were reduced to $PrO_{1.833}$ in the homologous series Pr_nO_{2n-2} with crystal integrity maintained. X-ray data were obtained on these crystals using Weissenberg and Hägg-Guinier cameras. The phase has a fluorite-type sublattice with a superstructure of monoclinic symmetry (space group $P2_1/n, C_{2h}^5$) and a unit cell having a = 6.687 Å, b = 11.602 Å, c = 15.470 Å, β = 125.257° and V = 979.6 Å^3. Indexing of the powder pattern of this phase was completed on the basis of this cell. The relationship to the fluorite subcell is shown. (auth)

17753 DEFECTS AND MASS TRANSPORT IN REDUCED CeO_2 SINGLE CRYSTALS. Ban, Y.; Nowick, A. S. (Columbia Univ., New York). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 353-65(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

A study is made of reduced CeO_2 in the form of large single crystals grown by arc fusion. It is shown that, so long as $y \ge 1.67$ in the formula CeO_y, all structural changes on reducing CeO_2 occur without loss of coherency of the original fluorite lattice. Comparison of length and lattice parameter changes shows that only oxygen vacancies (and no detectable Ce interstitials) are present in the reduced state. For $y > 1.67$, it is shown that oxidation (in air or in O_2) takes place at reasonable rates just above room temperature. The kinetics of this anomalously rapid mass transport are studied in some detail, including the effects of sample thickness and of oxygen partial pressure. The results show that the kinetics are neither diffusion nor surface controlled. A model of the process is developed which explains the major results. The low-temperature oxidation process does not terminate in the pure α (CeO_2) phase, but in a metastable structure, called α', for which y is very close to 2.0. The properties of α' are discussed. (auth)

17754 ANION CENTERED COORDINATION POLYHEDRA AND RELATED PHYSICAL PROPERTIES IN RARE EARTH OXIDES AND OXYSALTS. Caro, P. E. (CNRS, Bellevue, France). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 367-83(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

The structures of rare earth oxides and oxysalts can be conveniently described in terms of linkages of anion-centered coordination polyhedra, namely tetrahedra, yielding two- or three-dimensional frameworks. A complex "lanthanyl" cation $(LnO)_n^{n+}$ can be recognized. It has two different arrangements of tetrahedra, one of them being identical with the well known "bismuthyl" cation $(BiO)_n^{n+}$. The structural elements are similar to the classical SiO_2 and Si_xO_y ones; SiO_4 tetrahedra frameworks, used for silicates structures classification. Other anions than oxygen (sulfur and halides) yield isomorphous networks. Such types of structures imply some sort of covalent bonding. The covalence of the bond can be shown from optical measurements on solids. For (OLn_4) compounds the absorption spectrum is displaced to the red (nephelauxetic effect), a phenomenon which corresponds to the lowering of the Racah's parameters of the 4 f^n configuration. The mixing of the $|\,4\,f^n>$ wave functions with ligand wave functions also yields larger transition probabilities and the $(LnO)_n^{n+}$ materials are very effective phosphors. The layered oxide structures also yield textured thin films which exhibit epitaxial continuity and intergrowth between the rare earth oxides phases. The layered polymolecular complex cation concept can be applied to rare earth extended nonstoichiometric systems. It can be shown that the chemical composition of all the known phases of those systems can be accounted for in terms of the succession along a main crystallographic axis of four planar chemical units ABCD. Nonstoichiometry occurs because a layered structure AB is able to be interleaved through another layered structure ADCD. A general chemical formula for the ordered phases was derived, for the bastnaesite family of compound (AB = bastnaesite, ADCD = synchisite), the $Ln_2O_3-LnF_3$ systems (AB = tysonite, ADCD = trigonal EuOF), the LnO_x systems (AB = Ln_6O_{10}, ADCD = $Ln_{12}O_{22}$) and the $LnCl_3-LnCl_2$ system (AB = $LnCl_3$, ADCD = $LnCl_2$). All of the compounds contain layered polymolecular complex cations. (auth)

17755 PLASMA-SYNTHESIZED SUBTOICHIOMETRIC SCANDIUM OXIDE. Young, J. E. Jr.; Sienko, M. J. (Cornell Univ., Ithaca, NY). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 385-95(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Crystals of substoichiometric scandium oxide were grown in high frequency, induction-coupled, argon plasmas. The composition of the crystals could be varied by addition of small percentages

of hydrogen or oxygen to the argon stream. Chemical analysis by reoxidation indicated an oxygen deficiency that could attain 4% before metallic films appeared, concentrated at grain boundaries. The chemical composition of the films could not be established. X-ray studies of the bulk crystals indicated retention of the C-type rare earth structure of Sc_2O_3 with but slight shrinkage of the cubic cell parameter. Transmission electron microscopy showed no evidence for shear plane formation. Attempts to measure Hall voltage and conductivity by a van der Pauw technique gave conductivity values, both ac and dc, too small to measure. Faraday susceptibility measurements from 1.6 to 300°K indicated a very small effective magnetic moment, which decreased below 10°K. Possible models are F and F' centers in thermal equilibrium or Sc^{+1} ions with thermal equilibrium between ^3D and ^1D or ^3D and ^1S states. 39 references. (auth)

17756 CRYSTAL CHEMISTRY AND COMPOUND FORMATION IN THE SYSTEMS RARE EARTH SESQUIOXIDE–WO_3. McCarthy, G. J.; Fischer, R. D.; Johnson, G. G. Jr.; Gooden, C. E. (Pennsylvania State Univ., University Park). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 397-411(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Compounds with the following stoichiometries have been prepared in the rare earth sesquioxide–tungsten trioxide systems: RE_6WO_{12}, $RE_{10}W_2O_{21}$, $RE_{14}W_4O_{33}$, RE_2WO_6, and $RE_2W_2O_9$. Compounds of the first three stoichiometries prepared at 1400°C have structures apparently related to that of fluorite. RE_6WO_{12} has three structural classes whose symmetries are dependent on the rare earth ionic radius: La–Pr, cubic or pseudocubic; Nd–Gd, pseudotetragonal; Tb–Lu, Y, rhombohedral. $RE_{10}W_2O_{21}$ is stable only for RE = Gd–Ho, Y and has the same pseudotetragonal symmetry as the intermediate RE_6WO_{12} compounds. $RE_{14}W_4O_{33}$ has a pseudorhombohedral structure related to the third RE_6WO_{12} structure. The rhombohedral RE_6WO_{12} compounds are known to be isostructural with RE_7O_{12} oxides and it is suggested that $RE_{10}W_2O_{21}$ and $RE_{14}W_4O_{33}$ may be structurally related to RE_4O_7 and RE_6O_{11}, respectively. RE_2WO_6 compounds with RE = Pr–Dy have a monoclinic scheelite-related structure. The $RE_2W_2O_9$ compounds, also with a complex monoclinic structure, are stable only for RE = Ce–Gd (or Tb). Compounds of the stoichiometries $RE_4W_3O_{12}$ and $RE_2W_3O_{12}$ were not studied, but the literature information on them is noted. A discussion of the probable subsolidus phase relations in RE–W–O systems is also included. (auth)

17757 PREPARATION OF OXIDES AND RELATED COMPOUNDS BY CHEMICAL TRANSPORT. Schaefer, H. (Univ., Muenster, Ger.).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

In a temperature gradient it is possible for solids to migrate by sublimation, by catalytic sublimation (P_{red}/I_2), dissociative sublimation, and by chemical transport. Reversible heterogeneous reactions are utilized in chemical transport. The phenomenon is complex but can normally be treated as gaseous diffusion between spaces in which thermodynamic equilibrium has been established between solid and gaseous phases. The partial pressure drop between these spaces is the quantity which determines the suitability of a chemical reaction for transport processes. Information is given regarding working techniques and transport agents that have been employed hitherto. There is also an account of the binary oxides that have been chemically transported up to now and an account of the types of reaction used for transport. Using zinc oxide transport as an example, a demonstration is given of the selection of transport reactions on the basis of thermodynamic considerations. There is a discussion of syntheses in a temperature gradient and of "solid/solid reactions," with regard to the preparative employment of chemical transport processes. This discussion is illustrated with several examples. There is in addition a review of the transport of ternary compounds and of the decomposition of ternary compounds that can occur under the influence of the transport agent. Examples are given of the crystallization of metastable modifications out of the gas phase. (104 references). (auth)

17758 CARBIDES AND SILICIDES. Nowotny, H.; Boller, H.; Zwilling, G. (Univ., Vienna). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 487-504(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

A brief survey of the structural chemistry of transition element carbides is presented with emphasis on the problem of carbon-void ordering. The scandium carbides including $Sc_{15}C_{19}$ are discussed. Complex carbides which derive from octahedral and trigonal prismatic building elements are classified. Metal–metal carbides such as VCr_2C_2 and metal–nonmetal carbides such as Ti_3SiC_2, V_4P_2C, Nb_2SC, or Ta_2S_2C are interrelated. The role of nitrogen and hydrogen on the stabilization of complex carbides such as $Cr_3(C,N)_2$ or $Zr_2CH_{0.5}$ is also considered. Besides the class of typical interstitial carbides, some examples of metal boro-carbides displaying a two-dimensional boron-carbon network are given (YB_2C). In compounds such as $Cr_2(P,C)$ carbon plays an intermediate role. The present state of the problem of chemical bonding in carbides is also discussed. Binary metal silicides are numerous and occur almost at any composition. They are commonly classified as valence compounds (electronegative), metal-like silicides (electro-positive), and clathrate silicides (mainly electroneutral). Disilicides and related compounds exhibit a particularly wide occurrence. The continuous change of structural elements and properties of this group is discussed. So-called defect disilicides of formula T_nSi_{2n-m} (T = transition element) which are derived from the $TiSi_2$ type structure belong to a uniform building principle, where n presents the number of subcells and m the deviation from the disilicide composition. In many cases a relation of the electronic concentration with m can be observed. In general, lowering of the overall electron concentration diminishes the defect m. Singel crystal work on $Mn_{27}Si_{47}$ is described. This phase, a fifth variety having a composition in the vicinity of $MnSi_{\sim 1.7}$, presents the problem of pseudohomogenous domains. Some ternary silicides such as E-phases are discussed from the viewpoint of ordered structures. (78 references). (auth)

17759 INVESTIGATIONS IN THE TERNARY SYSTEM BORON–CARBON–SILICON. Gugel, E.; Kieffer, R.; Leimer, G.; Ettmayer, P. (Forschungs-Institut der Cremergruppe, Roedental, Ger.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 505-13(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Recent work on the system B–C–Si is reported. In contradiction, some publications confirmed the existence of B_4C only in the enclosing system boron–carbon. However, boron carbide is able to incorporate excess boron up to the composition $B_{6,5}$ (in solid solution) clearly showing a lattice expansion. Within the enclosing system silicon–boron there are the chemical compounds SiB_{4-x} ($x < 1$) and SiB_{12+x} ($x > 8$). According to the investigations the ternary system itself, in contrast to some other scientists, does not contain ternary phases as well as no solid solution between enclosing binary systems. Limited solid solutions exist around B_4C (+Si) and around SiB_{4-x} (+C). The x-ray investigations permit the presentation of phase distributions. (By means of a new method for determining the melting temperatures of high-temperature materials the liquidus areas (melting isotherms) of this system were investigated.) (auth)

17760 VALENCE BONDING IN SOME REFRACTORY TRANSITION METAL COMPOUNDS WITH HIGH COORDINATION. Carter, F. L. (Naval Research Lab., Washington, DC). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 515-59(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Bond formation in transition metal compounds isomorphous with WC and AlB_2 is formulated usirg the bidirectional orbital approximation (BOA) to establish orbital hybridization and a simple but self-consistent application of Pauling's metallic radii with charge transfer to obtain the bond orders. For tungsten carbide seven mutally orthogonal bidirectional bonding orbitals for the negative W atom permits it to simultaneously bond its fourteen neighbors with up to 6.5 electrons. However, bond polarization results in an effective negative charge for carbon of 0.0 to −0.3e. For the diborides the metallic radii results indicate that the group IV diborides have a slightly positive boron which becomes negative with increasing group number but remains below a charge of −1e. Four arguments are given for the pleating of the boron layer were it to be heavily charged as has been proposed earlier in the isoelectronic analogy to graphite. One of these involves a new definition of atomic volume based on the Voronoi polyhedron. Bond formation by the boron and carbon atoms in these compounds is discussed using the nonpaired spin–orbital [NPSO] approach of Linnett. Madelung constant and Madelung potential calculations via the method of Bertaut have been made for both the tungsten carbide and the $AlB_2(CdI_2)$ structure. These were computed in order to both estimate the magnitude of the electrostatic stability as a function of atomic parameters and to provide a basis for the comparison of ESCA chemical shift data with the calculated effective charge. The effects of bond formation in distorting the surfaces of constant energy in k space are also considered in these compounds with the aid of a simple square-well-potential model. The

principal directions of these distortions of the unreduced Fermi surface are indicated for the WC structures and as a function of the boron position parameter for the AlB_2 structures. It was noted that in both of these structures almost all the electrons outside the rare gas cores were involved in bond formation; this is in contrast to the refractory chalcogenides. (67 references). (auth)

17761 SIMPLE MODEL FOR THE STABILITY OF TRANSITION METAL CARBIDES. Lye, R. G. (Martin Marietta Corp., Baltimore). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 567-82(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

The origins of the unusual and complex combination of physical properties exhibited by the transition metal carbides remain somewhat obscure despite extensive studies of the problem in recent years. Even the qualitative nature of the bonding has not yet been described in a manner that accounts satisfactorily for the diverse and sometimes apparently contradictory experimental observations made on these compounds. One theme, however, recurring through the years of study, draws attention to the similarity of these compounds to the parent transition metals. This characteristic of the carbides is considered briefly in an attempt to provide a qualitative explanation for the manner in which the stability of the carbide phases varies with the position of the parent metal in the periodic chart of the elements. A simple model for the d band bonding in the transition metals, discussed by Cyrot-Lackmann, is modified for this purpose. In particular, it is assumed that a major component of the bonding in the carbides arises from crystalline electronic energy bands derived for the d states of the metal atoms. Because of changes in crystal structure, these bands are modified somewhat from the shape of the corresponding bands in the parent metal. Of greater importance for the stability of the carbides, however, is the increase in the width of the band, discussed by Costa and Conte, that results from the presence of the carbon atoms within the interstitial positions in the metal sublattice. As for the parent metals, the cohesion of the carbides is determined by the number of electrons in the d band. In the carbides, however, it is assumed that some of these electrons are provided by transfer from the 2p states of the carbon atoms. Thus, the stability, as measured by the heat of formation, results from the combined effects of the increase in the width of the d band and in the number of electrons it contains. Despite the considerable simplifications employed, an analytical formulation of this model yielded estimates for the heats of formation of the carbides that agree remarkably well with the experimental data presently available. (auth)

17762 ORDERING EFFECTS IN NbC AND TaC. Venables, J. D.; Meyerhoff, M. H. (Martin Marietta Corp., Baltimore). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 583-90(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Studies of the phase equilibria in the MC transition metal carbides have shown that they retain their nominal NaCl structure over a relatively wide phase field. Although it is well known that this wide latitude in composition is accomplished through the incorporation of carbon vacancies in the carbon sublattice, there is considerable uncertainty regarding the degree of order exhibited in most of the carbides by the remaining carbon atoms. An attempt was made to resolve this question for NbC and TaC using some of the techniques applied previously in a study of ordering in the vanadium-carbon system. By means of transmission electron microscopy and electron diffraction, evidence has been obtained for the existence of long-range carbon atom ordering in single-crystal niobium carbide that has a carbon-to-metal ratio close to the integral composition Nb_6C_5. The ordering, which gives rise to superlattice and domain structures similar to those observed in V_6C_5, appears, however, only in samples, that have been cooled slowly (~8°C/h) through the order-disorder temperature of 1025°C. In TaC of similar composition, the ordering, although present, remains very imperfect even after the crystals are subjected to the same thermal treatment. The results are interpreted in terms of the electronic structure of the transition metal carbides as it is currently understood, and their relevance to the mechanical properties of NbC and TaC are discussed. (auth)

17763 HIGH BORON CONTENT RARE-EARTH BORIDES. Spear, K. E.; Solov'ev, G. I. (Pennsylvania State Univ., University Park). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 597-604 (1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Investigations were performed to determine which rare-earth metals form LnB_{66} phases and to measure some of the properties of these compounds. Similar rare earth borides have been recently reported with B: Ln ratios of 50 to 100 for metals Y, Gd, Tb, Ho, and Yb. A single-crystal-structure analysis published on the yttrium compound shows the structure to be fcc with an ideal stoichiometry YB_{66}. Ten representative metals were used: Y, La, Ce, Pr, Nd, Sm, Gd, Dy, Er, and Yb. Boron-rich compositions were prepared by arc-melting mixtures of the elements. Identification of the phases in each sample was performed with the use of x-ray and metallographic techniques. All of the investigated systems except La, Ce, and Pr formed the LnB_{66} phase, and it is predicted that all rare-earth metals from Nd through Lu will form this phase. Lattice parameters were measured and show a general, but not regular decrease with atomic number. The LnB_{66} phases are extremely hard, with Vickers microhardness values ranging from about 3600 to 4000 kp/mm^2. Melting temperatures for the LnB_{66} phases were essentially the same for all metals, and equal to approximately 2150°C. (auth)

17764 PREPARATION AND CHARACTERIZATION OF BORON SUBOXIDE. Petrak, D. R. (Air Force Materials Lab., Wright Patterson Air Force Base, OH); Ruh, R.; Goosey, B. F. Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 605-11(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Fabrication techniques have been developed to produce specimens of near theoretical density by reaction hot pressing of boron and boric acid in vacuum at temperatures of 1900 to 2000°C and pressures of 0.41 kbars. The composition range 80 to 89 atomic % boron was investigated by chemical analysis, lattice parameter studies, pycnometric density determinations, electron probe analysis, and infrared analysis. Results support the $B_{12}O_2$ chemical formula and the $R\bar{3}m$ space group with twelve boron atoms in the 18th positions and two oxygen atoms in the 6c positions. Thus, on the basis of the experimentally determined hexagonal lattice parameters of $a = 5.386 \pm 0.003$ Å and $c = 12.326 \pm 0.004$ Å, the calculated density is 2.602 g·cm^{-3} and this is in good agreement with the experimentally determined value of 2.600 ± 0.007 g·cm^{-3}. The occupancy of the 3b position by either boron or oxygen (to allow the B_4O or $B_{13}O_2$ stoichiometry) is ruled out since this would require increases in density and/or lattice parameters and none were observed. Also these configurations do not satisfy the Longuet-Higgins and Roberts counting rule. The boron suboxide phase has been studied by electron probe and infrared analyses. The oxygen K emission spectra as well as the infrared reflection spectra are presented. Boron suboxide has been studied by mass spectrometric analysis and found to decompose to rhombohedral boron and B_2O_2. (auth)

17765 ORTHORHOMBIC PHASES IN THE SYSTEM YTTRIUM-OXYGEN-FLUORINE. Bevan, D. J. M. (Flinders Univ. of South Australia, Bedford Park). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 749-59(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Powder- and single-crystal-diffraction studies were made on the Y-O-F system. This system is believed to be an example of ordered phases in a range that previously was thought to be a classical nonstoichiometric phase. It is related to the fluorite system, and crystallographic shear planes are not involved. (PCH)

17766 PHASE REACTIONS NOT EXHIBITED ON THE USUAL PHASE DIAGRAM. Eyring, L. (Arizona State Univ., Tempe). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 761-3(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

Results obtained by sensitive yet long-used methods of observing phase reactions in solids not usually represented are discussed, with particular reference to oxygen pressure, temperature, and composition studies on rare earth oxides using thermogravimetric methods. The phase diagram of the praseodymium oxide-oxygen system is given as an example. It is pointed out that the tensimetric and gravimetric observations reveal exceedingly complex behavior not yet explicable but surely associated with coherent intergrowth of neighboring phases of the homologous series resulting in hysteresis and pseudophase formation. (PCH)

17767 CRITICAL TEMPERATURE OF SOLID ELECTROLYTES BASED ON ZIRCONIUM DIOXIDE. Ivanovskii, M. N.; Rutman, D. S.; Shmatko, B. A.; (and others) (Physical Power Inst., Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 590-592(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 658-659 (1972).

The critical temperature T_{cr} for the transition from mixed electric conductivity to pure oxygen-type conductivity was measured by the emf method for an electrolyte composed of ZrO_2 + 10 mole % Y_2O_3 (density 5.3 g/cm^3 and porosity 0.3%). T_{cr} was found to be 235°C, indicating that this electrolyte may be used in oxygen thermodynamic investigations over a wide temperature range, from >500°C down to 235°C. The critical partial oxygen pressure was calculated to be lg P_{cr} = 11.7 − (22,839/T), with P_{cr} being 10^{-33} atm at 235°C. (DLC)

17768 APPLICATION OF THE HV-MICROSCOPE IN THE DEVELOPMENT OF TiC−COATED CUTTING TOOLS. Lehtinen, B. Jernkontorets Ann.; 155: No. 8, 446-448(1971).

Surface treatment affects the nucleation and growth of TiC on different substrates. HVEM showed that dislocations serve as nucleation sites for TiC growth. (Metals Abstr.)

17769 SILICON DIFFUSION IN THE Me_5Si_3-PHASE OF NIOBIUM, TANTALUM, MOLYBDENUM, AND TUNGSTEN AT 1700°C. Fitzer, E.; Schmidt, F. K. High Temp.-High Pressures; 3: No. 4, 445-460(1971). (In German).

The reported role played by M_5Si_3 phases of the high-melting metals Nb, Ta, Mo, and W, formed by selective oxidation of disilicides, as well as by diffusion of Si from silicide protective-coating systems with the base metal, is discussed. It is shown that the growth of the M_5Si_3 interlayer is solely controlled by the Si diffusion, with the Si transport rate through the M_5Si_3 phases decreasing in the order: $Mo_5Si_3 > W_5Si_3 > Nb_5Si_3 > Ta_5Si_3$. In comparison with the Si transport, the metal interdiffusion is much slower using $MoSi_2$−Ta and $MoSi_2$−W as examples. The partial diffusion coefficients for Si in Mo_5Si_3 and Nb_5Si_3 phases are calculated by first establishing the range of homogeneity by microprobe analysis and then determining the layer growth rates. In addition, it is shown that differences in the activity of Si in MSi_2 phases can significantly influence the growth of the M_5Si_3 interlayer. Experiments on diffusion in pairs of the type $M_ISi_2-M_{II}$ have shown that the rates of formation of the $(M_I,M_{II})_5Si_3$ phases correspond to those calculated on the basis of the diffusion data for MSi_2−M pairs, any divergences being accounted for by differences in the activity of Si. The inferences stemming from the diffusion data are discussed in relation to the selective oxidation of Si and diffusion of Si out of protective coating systems and in relation to evaporation of Si. (Metals Abstr.)

17770 MEASURES OF RESISTIVITY AND KINETICS OF OXIDATION OF PuO_{2-x}. Chereau. P.; Wadier, J. F. (CEN, Fontenay-aux-Roses, France). J. Nucl. Mater.; 46: No. 1, 1-8(Feb 1973). (In French).

The electrical resistivity of PuO_{2-x} was measured between $PuO_{1.77}$ and $PuO_{2.00}$ in the temperature range 700 to 1200°C. It is concluded that the major defect species are anion vacancies. The kinetics of oxidation was measured at 1080°C. The chemical diffusion coefficient of oxygen was computed and the oxygen self-diffusion coefficient is derived as a function of the deviation from stoichiometry. (auth)

17771 EFFECT OF DISPERSED PARTICLES ON THE PROPERTIES OF Mg—MgO COMPOSITES. Splichal, K. (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 19: No. 2, 55 58(Feb 1973). (In Czech.).

Structural instability of Mg−MgO composites was examined at higher temperatures. The decomposition of dispersed oxide particles during annealing of the sintered compacts at temperatures above 450°C results in gas release, which causes the appearance of secondary porosity and surface blistering. The thermal treatment of the billets or the addition of the dispersion of certain metals, especially of Be, with particle size under 25 mm improve the structural stability and mechanical properties of compacts. (auth)

17772 P/M IN ORDNANCE. PART ONE. 1971 Conference Proceedings, Philadelphia, Pennsylvania, June 2-3, 1971. Progress in Powder Metallurgy, Volume 27. New York; Metal Powder Industries Federation (1971). 173p. $25.00. (CONF-710659).

Nineteen papers were presented at the conference. A separate abstract was prepared for each of three papers selected as being in the scope of NSA. (JRD)

For abstracts of individual papers see: 17773, 17774, and 17860.

17773 POTENTIAL FOR POWDER METALLURGY APPLICATIONS IN ARMY MATERIAL. Kleppinger, D. H. (Frankford Arsenal, Philadelphia). Progr. Powder Met.; 27: Pt. 1, 85-91 (1971).

From Proceeding of the 1st Tutorial Seminar on P/M in Ordnance; Philadelphia, Pennsylvania, United States of America (USA). (2 Jun 1971).

See CONF-710659-.

Test firings of penetration-type ordnance material composed of mild steel, 52100 steel, WC, 90 W−Ni−Cu, 95 W−Ni−Cu−Fe, depleted U, U−8.5 Mo, and U−1.25 Ti are reported. It is noted that specific performance data are complex; however, it appears that high-density W alloys have the best properties for use in projectiles. (JRD)

17774 STRATEGIC IMPORTANCE OF TUNGSTEN AND OTHER REFRACTORY METALS IN DEFENSE INDUSTRY. Belous, W. T. (Teledyne, Glen Cove, NY). Progr. Powder Met.; 27: Pt. 1, 118-120(1971).

From Proceeding of the 1st Tutorial Seminar on P/M in Ordnance; Philadelphia, Pennsylvania, United States of America (USA) (2 Jun 1971).

See CONF-710659-.

The strategic importance of W and WC and their use in cutting tools and in snow tire studs are discussed via questions and answers, with brief reference to metallurgical problems. (JRD)

17775 STUDY OF THE WEAR PROCESSES ON CEMENTED CARBIDE CUTTING TOOL BY A RADIOACTIVE TRACER TECHNIQUE. Lunde, G.; Anderson, P. B. Int. J. Mach. Tool Des. Res.; 10: No. 1, 79-93(Mar 1970).

Results of studies of the material transferred from tool to chip using carbide cutting tools and a plain carbon (0.6 per cent C) steel workpiece are discussed. The cutting tools were neutron activated and the chips were examined by gamma spectroscopy and by microautoradiography. It was noted that the amount of CO transferred to the chips was high during a running-in period and decreased with time until the Ta/CO ratio in the chips equaled that in the tool. The running-in time and the absolute wear of the tool (i.e., the total radioactivity of the chips) were found to depend on tool type as well as cutting speed. Regions of high activity noted on the chips by autoradiography were much larger than similar regions on the tools. This was taken to indicate that the carbide particles from the tool decomposed in an iron layer formed at the tool-workpiece interface before being transferred to the chips. Only at very high cutting speeds was the distribution of activity on autoradiographs of the chips similar to that of the tools, indicating under these conditions that carbide particles were being transferred directly from the tool to the chip without decomposition. It was concluded that tool wear occurs mainly by decomposition and dissolution of carbides in the tool into the above-mentioned iron zone which is then transferred to the chip. It is suggested that CO is transported to the chip by a diffusion process. (App. Mech. Rev.)

17776 CONTROL OF THE FABRICATION OF CERAMIC PELLETS. Leblanc, J. M. (to Societe Belge pour l'Industrie Nucleaire). Belgian Patent 780,344. 8 Mar 1972. (In French).

A method for the control of ceramic pellets fabricated by classical steps is described. The pelleting of the powders, the fritting of the pellets and the rectification of the diameter of the pellets after fritting are described. The control of the density after fritting is done by strictly regulating the diameter of the pellets. (tr-auth)

17777 ACCURATE FABRICATION PROCEDURE OF FUEL PELLETS. Flipot, A. J.; Smolders, A. (to Centre d'Etude de l'Energie Nucleaire). Belgian Patent 781,180. 24 Mar 1972. (In French).

A procedure for compacting and fritting, which permits the fabrication of pellets whose diameter variation remains within the tolerances imposed, is described. The rectification step can be avoided. (tr-auth)

17778 SWITCHING EFFECT IN PYROLYTIC VO_2 FILMS. Zhdan, A. G.; Darevskii, A. S.; Chugunova, M. E.; Serbinov, I. A. (Inst. of Radio Engineering and Electronics, Moscow). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 7, 1879-1880(Jan 1973).

Translated from Fiz. Tverd. Tela; 14: No. 7, 2170-2172(Jul 1972).

VO_2 films 0.1 to 1 μ thick were produced by the pyrolytic decomposition of vanadium acetylacetonate on pyroceram substrates. The temperature dependence of conductivity, volt−ampere pulse characteristics, dependence of switching time on voltage, and quasi-static and pulse switching effects are shown for VO_2 films with Au electrodes. Results indicate thermal breakdown and electrothermal mechanisms, while the phase change mechanism is ruled out. (DLC)

17779 INVESTIGATION OF CHANGES IN THE SURFACE LAYERS OF CARBIDES OF REFRACTORY METALS AFTER

ELECTRIC SPARK MACHINING. Lemeshko, A. M.; Rogozinskaya, A. A. Elektron. Obrab. Mater.; No. 2, 18-22(1972). (In Russian).

Changes in the structure, composition, and properties of carbides of titanium, niobium, and tungsten after electric spark machining were studied. The specimens were prepared by hot pressing followed by homogenization by annealing. The composition of the carbides was close to stoichiometric. The porosity of the specimens was 2 to 4%, and grain size was no greater than 40 μ. Surface layer changes were studied after finishing operations characterized by an energy of up to 0.01 J in a unit pulse. Metallographic studies showed that the microstructure of the surface layer does not undergo any appreciable changes. The surface relief shows increased unevenness and surface destruction with increasingly stringent machining conditions. Microhardness and microbrittleness also change noticeably with an increase in the severity of working conditions. It is concluded that decarbonization of the surface layer leads to formation of carbide phases in regions of homogeneity (if these regions are extensive), or new phases if the extent of the regions of homogeneity is not great. It is shown that machining of hexagonal tungsten carbide results in formation of its cubic modification. (JPRS)

17780 WETTING OF ZIRCONIUM NITRIDE WITH NICKEL–COBALT ALLOYS. Munaev, Yu. A.; Iksanov, B. A.; Marmynov, S. E.; Famkullin, O. Kh. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 9, 13-15(1972). (In Russian).

Results are presented from an experimental study of the equilibrium contact wetting angles as a function of composition, dynamics of change of contact angles during wetting, and spreading rate of liquid alloys over a solid coating. The specimens of zirconium nitride used were produced by precipitation from the gas phase onto a substrate of MPG-6 graphite. The thickness of the coatings was 0.7 to 1.0 mm. The total content of impurities in the nitride coating was not over 0.01%. The test data showed that the wetting of zirconium nitride by a nickel–cobalt alloy occurs by the mechanism of formation of adsorption layers by surface diffusion. Enrichment of the alloys with nickel apparently causes formation of thick, thermodynamically stable adsorption layers, while enrichment with cobalt causes formation of unstable adsorption layers, so that the liquid metal collects into drops. (JPRS)

17781 HIGHLY HEAT-RESISTANT CERMET ALLOY AND METHOD FOR ITS PREPARATION. Bredzs, N. (to Wall Colmonoy Corp.). German Patent 2,144,156. 13 Apr 1972. 39p. (In German).

A highly heat-resistant cermet alloy was developed that exhibits an extraordinarily good resistivity to sulfidization. Heat and sulfidization-resistant protective coatings on metal substrates can also be prepared, however, using the procedure of bars and preformed parts. The cermet alloy consists of a dense, nonporous continuous metal matrix made of chromium and nickel and/or cobalt which in the concentrated state is penetrated by discrete discontinuous phases of fireproof aluminum oxide particles and ceramic compounds. The latter consist mainly of titanium boride zirconium boride, and mixtures of these. (GF)

17782 APPARATUS FOR THE FABRICATION OF PLUTONIUM OXIDE SPHERES WITH A DIAMETER IN THE ORDER OF 10 MICRONS. Jones, L. V.; Ofte, D.; Tucker, A.; Wittenberg, L. Jr. (to United States Atomic Energy Commission). German Patent 1,439,816. 18 May 1972. 4p. (In German).

An apparatus is described for the preparation of plutonium oxide spheres with a diameter of the order of 10 to 250 microns. The spheres are made of sintered and ground plutonium oxide particles by means of a plasma flame using an argon–oxygen mixture for the melting of the oxide particles, which is fed into a quartz tube through a radial pipe. The quartz tube is surrounded by a high-frequency induction coil where an air-contained zone is connected to the melting zone in order to cool the oxide particles. (GF)

17783 INFLUENCE OF IMPURITY PARTICLES ON THE FRACTURE OF UO_2. Solomon, A. A. (Argonne National Lab., IL). J. Amer. Ceram. Soc.; 55: No. 12, 622–627(Dec 1972).

Three types of second-phase precipitates were identified by scanning electron microscopy of helical specimens of nominally pure UO_2, i.e. (1) bonded or weakly bonded complex Si particles precipitated during sintering from impurities in the starting material, (2) more strongly bonded Al_2O_3–UO_2 surface particles that formed on the external surfaces during sintering, and (3) metallic Fe or U phases. The influence of these particles on the room-temperature fracture stress, σ_f, was investigated. Particles of types (1) and (2) were as large as 300 μm and caused up to 100% reduction in σ_f, whereas the metallic phases had no significant effect. The critical-strain-energy-release rate, G_c, determined from the measured flaw sizes and associated fracture stresses, was ≈3600 ergs/cm^2. Purification procedures that reduced the impurity particle sizes and number density improved the strength significantly. (auth)

17784 SOLUBILITY OF OXYGEN IN ZrC. Sarkar, S. K.; Miller, A. D.; Mueller, J. I. (Univ. of Washington, Seattle). J. Amer. Ceram. Soc.; 55: No. 12, 628–630(Dec 1972).

Zirconium carbide specimens containing significant quantitites of dissolved oxygen were synthesized using ZrO_2 and graphite as reactants in an atmosphere of CO. These specimens were studied by x-ray diffraction and analyzed chemically for C, O, and Zr. The data indicate that oxygen substitutes in the ZrC lattice, replacing more than 1 C atom/O atom, thus decreasing the lattice parameter. Under the conditions of the study, the reaction product is a solution of oxygen in the ZrC phase rather than a distinct oxycarbide phase. (auth)

17785 DIFFUSION DATA, VOLUME 7, NO. 1, 1973. Woehlbier, F. H. (ed.). Diffus, Data; 7: No. 1, 1–175(1973).

New information on diffusional mass transport in and through crystalline and amorphous solids and in liquid substances that are solid at normal temperature and pressure is compiled. The presentation of the information is divided into groups of host substances including solid metals and alloys, liquid metals and alloys, semiconductors (excepting oxides), solid oxide systems, liquid oxide systems, solid halides and other ionic crystals, liquid halides and other ionic substances, and miscellaneous materials. Within each section, the data are presented in alphabetical order of the host substances. In addition, other pertinent references in the field that are not suited for detailed coverage in the main section are given, as well as book reviews and regular listings of selected notices of research projects currently in progress as prepared in co-operation with the Smithsonian Institution's Science Information Exchange. (JRD)

17786 KINETICS OF THE UO_2–C–N_2 REACTION AT 1700°. Lindemer, T. B. (Oak Ridge National Lab., Tenn.). J. Amer. Ceram. Soc.; 55: No. 12, 601–605(Dec 1972).

The mechanism of the reaction of UO_2 with carbon in the presence of N_2 at 1700°C and the rate of formation of the carbonitride product were determined. Uranium carbonitride forms at specific O_2 and N_2 chemical potentials by reactions such as (1) $UO_2(s) + 0.67HCN(g) \rightarrow UO_{1.33}N_{0.45}(s) + 0.67CO(g) + 0.11N_2(g) + 0.335H_2(g)$ and (2) $UO_{1.33}N_{0.45}(s) + 1.58HCN(g) \rightarrow UC_{0.25}N_{0.75}(s) + 1.33CO(g) + 0.79H_2(g) + 0.64N_2(g)$. At $P_{H_2} = 2 \times 10^{-5}$ atm, HCN formed, permitting a gas-phase transport of reactants not observed in the UO_2–C reaction. Reaction (1) is completed in 0.01 to 0.1 of the time for complete conversion to carbonitride; reaction (2), which proceeds as soon as oxynitride is available, is controlled by solid-state diffusion across the carbonitride layers after they become continuous on the entire specimen. The reaction rates and product compositions depend on the P_{N_2} and P_{CO} in the system. (auth)

17787 NUCLEAR FUEL HAVING MINIMUM-GAS-RELEASE PROPERTIES. Pechin, W. H.; Bradley, R. A.; Sease, J. D. (to United States Atomic Energy Commission). U. S. Patent 3,689,428. 5 Sep 1972. Filed 8 Jun 1970.

An improved nuclear fuel composition is described which is characterized as a hypostoichiometric solid solution of an oxide of plutonium and uranium. The fuel has a surface-to-volume ratio of greater than 100 in.$^{-1}$ and a gas-release index of no more than 0.1 cm^3/g of fuel as measured at 1600°C. The process for making such fuel is described. (Official Gazette)

17788 PRODUCTION OF URANIUM AND PLUTONIUM CARBIDES AND NITRIDES. Coppinger, E. A.; Johnson, B. M. (to United States Atomic Energy Commission). U. S. Patent 3,697,436. 10 Oct 1972. Filed 26 Nov 1969.

Sugar is dissolved in an aqueous solution of an actinide nitrate, such as uranium and/or plutonium nitrate, and the resulting solution is subjected to radiant-heat spray calcination, producing a calcined mixture of carbon with actinide oxide. This intimately mixed, highly reactive mixture is then heated at a high temperature in the presence of nitrogen to produce actinide nitride or, in the presence of an inert gas, to produce the corresponding carbide. (Official Gazette)

17789 PREPARATION OF FERROELECTRIC CERAMIC COMPOSITIONS. Dosch, R. G.; O'Neill, W. M. (to United States Atomic Energy Commission). U. S. Patent 3,699,044. 17 Oct 1972. Filed 16 Sep 1970.

Preparation of ferroelectric ceramic, refractory oxide, compositions is described. First, a metal alkoxide is mixed with a quaternary ammonium hydroxide to obtain a solution containing a soluble metal complex ion. A metal salt is then mixed with the

solution to form a precipitate which is filtered and calcined to the refractory oxide composition. (Official Gazette)

17790 GRADIENT-TYPE NUCLEAR FUEL PLATE. Knight, R. W.; Martin, M. M.; Martin, W. R. (to United States Atomic Energy Commission). U. S. Patent 3,697,374. 10 Oct 1972. Filed 3 Nov 1970.

Gradient-type nuclear fuel plates exhibiting minimal blister formation are provided by introducing an inert ceramic dispersoid into the filler material of the fuel plate, said dispersoid providing a void volume of between about 2 to 4 vol % in said filler material. In one embodiment a gradient-type nuclear fuel plate comprising an aluminum-base dispersion fuel, clad with aluminum metal, is prepared in which the dispersoid is alpha-phase Al_2O_3. (Official Gazette)

17791 DEFORMATION PHENOMENA OF HIGH-STRENGTH WC–Co ALLOYS STUDIED BY MEANS OF A NEW ELECTRON MICROSCOPE REPLICA LOCATING TECHNIQUE. Jaensson, B. O. (Chalmers Univ. of Tech., Goteborg). Prakt. Metallog.; 9: No. 11, 624-641(Nov 1972). (In English and German).

The tensile side of bending test pieces loaded to very high stresses or fractured was examined by replica electron microscopy for traces of deformation. In order to make the observations reliable in finest detail, a procedure for matching and comparison of two or more replicas (e.g., taken before and after deformation) was used. Densitometric evaluation of the image contrast resulting from the metal-shadowed replicas was used to reconstruct the actual surface profile of some specimens. Two types of deformation phenomena were found, namely WC–WC grain boundary cracks and microplastic deformation of carbide grains near phase boundaries. The latter effect, which reveals itself in the form of double contours in the replica electron micrographs, is discussed as to its physical background. Similar double contours are visible in micrographs published earlier by others, but they do not seem to have been explained, or even noticed. (auth)

17792 ISSLEDOVANIE TERMICHESKOI STOIKOSTI OGNEUPORNOI KERAMIKI. (Investigation in Thermal Stress Resistance of Refractory Ceramics). Dauknis, V.; Kazakyavichyus, K.; Prantskyavichyus, G.; Yurenas, V. Vilnyus, USSR; Izdatel'stvo Mintis (1971). 151p.

Results of investigations relating to high temperature thermophysics are presented and examined. Theories of thermal fracture are discussed and a series of experiments devoted to investigation of internal and external energy storage in specimens undergoing thermal fracture is described. Methods for use in conducting thermal stress experiments are summarized and equipment designed for thermal resistance measurements in cylindrical and ring-shaped specimens at maximum temperatures of 2500°K is described. Descriptions are included of methods of determining mechanical and physical properties such as strength, modulus of elasticity, thermal expansion, thermal conductivity, and diffusivity. Ways of improving refractories are discussed. (JRD)

17793 GLASS FORMATION AND PROPERTIES IN THE $Ag_2O–TeO_2–V_2O_5$ SYSTEM. Dimitriev, J. B.; Marinov, M. R.; Ivanova, I. I. (Higher Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 9, 1205-1208(1972).

Results of glass formation studies show that under the particular conditions investigated it is possible to obtain glasses containing up to 35 mole % Ag_2O. No pure glasses without crystallization were synthesized in the $TeO_2–Ag_2O$ system. It is noted that activation energy depends directly on the average distance between the ions of the V lattice. From this it is assumed that when activation energies are low the structure of the glass is largely determined by suitably oriented V–O structural elements. (JRD)

17794 VARIATION OF Λ DOUBLING WITH ROTATIONAL QUANTUM NUMBER: BeH AND BeD. Hinkley, R. K.; Walker, T. E. H.; Richards, W. G. (Oxford Univ.). J. Phys., B (London); 5: No. 11, 2016-24(Nov 1972).

The variation of Λ doubling with rotational quantum number is investigated for BeH and BeD. Hartree–Fock wavefunctions are used to calculate accurate matrix elements of the Coriolis operator from which the Λ doubling constants are deduced. For BeH an experimental maximum in the Λ doubling is confirmed, whereas no maxima are predicted in the case of BeD. These facts are simply rationalized in terms of the likely potential curves. It is concluded that a second-order perturbation treatment, invoking the concepts of "pure precession" and the Born–Oppenheimer approximation, works very well for these molecules. (auth)

17795 CRYSTAL STRUCTURE OF THE MAu_2Si_2 RARE EARTH COMPOUNDS. Mayer, I.; Cohen, J.; Felner, I. (Hebrew Univ., Jérusalem). J. Less-Common Metals; 30: 181-184(1973).

MAu_2Si_2 type compounds of the La–Er rare-earth metals crystallize in the $ThCr_2Si_2$-type body-centered tetragonal structure. Lattice constants and atomic parameters were determined, and the interatomic distances calculated and compared with corresponding data of MAg_2Si_2 compounds. The radii R_{Au} = 1.36 Å and R_{Au} = 1.18 Å found were very close to the ionic radii of these atoms. The radii of silicon has the value of the atomic radius in the silver compounds and the covalent radius in the gold compounds. (auth)

17796 $SrO.Eu_2O_3.Fe_2O_3$ PHASE IN THE SYSTEM $SrO–Eu_2O_3–Fe_2O_3$. Drofenik, M.; Kolar, D.; Golic, L. (Univ., Ljubljana, Yugoslavia). J. Less-Common Metals; 30: 309-310(1973).

In an investigation of equilibrium relations in the system $SrO–Eu_2O_3–Fe_2O_3$ a new ternary compound with molar composition 1:1:1 was identified. The compound $SrEu_2Fe_2O_7$ was prepared by firing a mixture of stoichiometric amounts of reagent grade $SrCO_3$, Eu_2O and Fe_2O_3 at 1300°C. To ensure homogeneity, fired samples were crushed, mixed, repressed, and fired again several times. Equilibrium was considered to have been attained when x-ray-diffraction patterns of successively heated samples showed no further change. The melting behavior of the compound was investigated in a hot-stage microscope at temperatures up to 1700°C in air. Visual observation of the sample during slow heating and the analysis of shrinkage curves obtained on the basis of photographs, revealed that the compound melts at a temperature of 1590° ± 15°C. (JRD)

17797 THERMAL PHASE EQUILIBRIA OF THE $BaO–TiO_2–V_2O_5$ SYSTEMS. Solacolu, R.; Dinescu, R.; Zaharescu, M. (Inst. of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 15: No. 3, 401-408(Mar 1970). (In German).

Thermal phase equilibria were determined for the system $BaO–TiO_2–V_2O_5$. To determine the boundaries of the primary crystallization fields of the individual phases, the method of high-temperature microscopy was used. The solid phases in thermal equilibrium were determined roentgenologically, microscopically, and with electronic microprobes. The phase diagram obtained depicts not only the eutectics and peritectics but also the boundary lines between the primary crystallization fields of the unary and binary compounds but also those of the ternary compounds with a composition of $3BaO \cdot 3TiO_2 \cdot 2V_2O_5$. The latter were characterized roentgenographically and microscopically. (tr-auth)

Metals and Alloys

Refer also to abstract 17059.

Corrosion and Erosion

Refer also to abstract 17180.

17798 (AE-461) CAUSTIC STRESS CORROSION CRACKING OF ALLOYED STEELS: AN ELECTROCHEMICAL STUDY. Dahl, D.; Dahlgren, T.; Lagmyr, N. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1972. 44p. Dep. NTIS (U. S. Sales Only).

Electrochemical studies of stress-corrosion cracking of 3 Cr–Mo, 12 Cr, 12 Cr–Mo–V, and 18 Cr–8 Ni-steels in 20% NaOH at 225°C were performed. Stress-corrosion cracking has occurred at both cathodic and anodic potentials with 3 Cr–Mo-steel and 18 Cr–8 Ni-steel. Most failures in the 12 Cr–steel have been due to general corrosion. The use of electrochemical protection can not be regarded as a reliable method. (auth)

17799 (KFK-1659) WEAR CHARACTERISTICS OF MATERIAL COMBINATIONS IN LIQUID SODIUM. Test Installation and Experimental Results. Wild, E.; Mack, K. J.; Drechsler, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Nov 1972. 64p. (In German). Dep. NTIS (U. S. Sales Only).

Investigations of reactor materials wear behavior require experimental facilities that provide for simulation of operating conditions existing in the components of sodium-cooled reactor facilities. Parameters such as the oxide content of the liquid metal or the flow velocity can be produced only in mockup loops equipped with a significant amount of measuring and control instruments. Highly sensitive instruments are used to measure the sometimes minor changes of shape of material specimens caused by wear. An experimental facility is described along with measuring and safety devices for carrying out wear tests in sodium up to 600°C. Experimental results obtained before June 1972 are discussed and tabulated. (auth)

17800 (KFK-1681) INFLUENCE OF COLD WORK UPON THE CORROSION RESISTANCE OF AUSTENITIC CrNi STEELS IN

SUPERHEATED STEAM. 2. STATIC EXPERIMENTS USING INCOLOY ALLOY 800 IN DIFFERENT GRAIN SIZES. Leistikow, S.; Pott, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Dec 1972. 26p. (In German). Dep. NTIS (U. S. Sales Only).

Using Incoloy Alloy 800 sheet specimens of different grain sizes, the extent of oxide formation by superheated steam as function of cold deformation was tested. Sheet specimens of three different grain classes (50 to 100, 100 to 150, 150 to 300 μm) were produced by heat treatments in argon at 1050, 1150, and 1300°C and by cold rolling to 10, 30, 50, 70, 85, and 90% of the original thickness. In the electropolished condition these sheet specimens were tested during 1000 hours at 600°C and 70 atm in autoclaves. In general, the experiments resulted in a considerable reduction of corrosion related to the increasing cold work. The grain size dependent differences in corrosion behavior, still present at high degrees of cold work, are gradually reduced so that the groups of values attributed to the different grain classes converge at minimum corrosion values of 25 to 50 mg/dm^2 metal loss. (auth)

17801 NOVYI METALLICHESKII PLENKI I POKRYTIYA (NEW METAL FILMS AND COATINGS). Syrkin, V. G. Moscow; Znanie Press (1972). 32p.

Among the many chemical methods of production of metal films and coatings, the vapor phase method of thermal decomposition of volatile metal compounds, allowing metal layers to be produced at temperatures far below the melting points of the corresponding metals and alloys, has attracted interest recently. Thermal dissociation methods have great potential capabilities. Significant progress has been achieved in this direction in recent years, primarily due to the use of metal halides and carbonyls, as well as certain organometallic compounds. Descriptions of the thermal decomposition of metal carbonyls and halide derivatives are presented along with methods of cleaning substrate surfaces. Information is also included on anticorrosion metal coatings, refractory coatings, thin metal films, ferromagnetic films, magnetic layers, and metallization of powders, diamonds, fibers, fabrics, and paper. (JRD)

17802 REPLACEMENT OF CHEMISORBED GASES ON METAL SURFACE. Sugita, Toshio; Ebisawa, Shigeo; Kawasaki, Koji Denki Shikensho Iho; 36: No. 8-9, 580-593(1972). (In Japanese).

Experimental facts concerning the replacement of chemisorbed gases on metal surfaces are reviewed and summarized and are classified into two different types of replacement: simple mutual replacement and replacement with surface reaction. The adsorption surface reaction and mutual replacement of CO, CO_2, and O_2 on clean films of titanium, palladium, and nickel evaporated under ultrahigh-vacuum conditions are studied by measurement of the electrical resistance and simultaneous observation of the phenomena by using a mass spectrometer. From the above experiments it is suggested that the sequence of the adsorption strength on the metal film obtained from the replacement measurement is coincident with the sequence of the heat of gas adsorption. (22 figures, 34 references) (auth)

17803 INTERACTION OF OXYGEN WITH HOT TUNGSTEN FILAMENT. Hayashi, Nobuyuki. Denki Shikensho Iho; 36: No. 8-9, 611-615(1972). (In Japanese).

The interaction of oxygen with a hot tungsten filament was studied by a technique of isotopic mixing. When the tungsten filament placed in the center of a spherical glass cell is flashed in isotopic oxygen, $^{18}O_2$ of 10^{-6} torr, $C^{18}O_2$, $C^{18}OO$, $C^{18}O$, and ^{18}OO appear each in a gas phase. In this experimental system, necessary conditions for the production of these evolved gases are clarified. It is shown that isotopic carbon monoxide and carbon dioxide are mostly evolved from the surface of the glass cell rather than caused by the interaction of gaseous $^{18}O_2$ with the hot tungsten surface. After the flashing of tungsten in gaseous $^{18}O_2$, the isotopic exchange reaction of ^{18}O in the tungsten filament with gaseous CO is studied. The activation energy for the reaction is estimated in the range from 2.2 to 4.1 eV. (auth)

17804 ADSORPTION AND DISSOCIATION OF CO ON TUNGSTEN SURFACE STUDIED BY FIELD-EMISSION MICROSCOPY. Senzaki, Kiyoshi; Kawasaki, Koji. Denki Shikensho Iho; 36: No. 8-9, 616-622(1972). (In Japanese).

The adsorption and desorption of CO on tungsten were studied by using a field-emission microscope with static or pulsed field to make clear the location corresponding to binding states of CO adsorbed on the tungsten surface, i.e., one weakly bound α state and three more strongly bound β states, distinguished by flash-desorption measurements. CO in the α state is found on all the planes of tungsten, whereas CO in the β states depends on the surface structure. From the field-emission patterns of CO adsorbed on tungsten at above 600°C, it is suggested that there is a possibility of dissociation of CO on hot tungsten. 12 figures. (auth)

17805 STUDY OF THE REDUCTION OF CO ADSORBED ON TUNGSTEN WITH HYDROGEN BY FIELD-EMISSION MICROSCOPY. Senzaki, Kiyoshi; Kawasaki, Koji. Denki Shikensho Iho; 36: No. 8-9, 623-626(1972). (In Japanese).

Reduction of CO adsorbed on the tungsten surface by hydrogen at high temperatures is studied using a pulsed field-emission microscope. The three dark spots on the {334} plane are observed in the reduction process of carbon monoxide adsorbed on hot tungsten with hydrogen. From the above measurements, it is suggested that there is a possibility of dissociation of carbon monoxide in the hot tungsten surface. (auth)

17806 CONSIDERATIONS OF THE HETEROGENEOUS NUCLEATION THEORY BY MEASURING THE CONTACT ANGLES OF GOLD AND SILVER ON A CLEAN TUNGSTEN SUBSTRATE. Sugita, Toshio; Ebisawa, Shigeo; Kawasaki, Koji. Denki Shikensho Iho; 36: No. 8-9, 627-631(1972). (In Japanese).

The contact angle plays a significant role in the kinetics of heterogeneous nucleation from metal vapor on solid surfaces. The nucleation rate (J) of cap-shaped nuclei from the vapor is described by the expression: $J = A \sin\theta \exp(-\Delta G^*/kT)$, $\Delta G^* = B\gamma^3\phi(\theta)$, $\phi(\theta) = 1/4\,(2 - 3\cos\theta + \cos^3\theta)$. Here, θ is the contact angle, ΔG^* is the free energy of formation of the nucleus, A and B are constants, and γ is the interfacial free energy of condensate/vapor interface. If θ is zero, ΔG^* is zero and J must be zero according to the equation. This low rate is not realized in practice. The situation has been clarified by measuring the contact angles for gold and silver on a clean tungsten substrate under ultrahigh vacuum by the sessile drop method. (auth)

17807 EPITAXIAL GROWTH OF SILICON ON TUNGSTEN SURFACE. Senzaki, Kiyoshi. Denki Shikensho Iho; 36: No. 8-9, 640-643(1972). (In Japanese).

The epitaxial growth of silicon on the tungsten surface at 1,000°C was studied with a field-emission microscope. Adsorption of silicon at low pressure (to 10^{-8} torr) of SiH_4 is strongly dependent on the surface structure of tungsten. Epitaxial growth of Si at the pressure of 10^{-5} torr of SiH_4 takes place initially at areas around {011} planes, and then proceeds all over the surface. The work function of Si film adsorbed on tungsten at 1,000°C is found to be about 4.75 eV by field-emission measurements. (auth)

17808 EFFECTS OF RADIATION AND OXYGEN ON THE AQUEOUS OXIDATION OF ZIRCONIUM AND ITS ALLOYS AT 290°C. Bradhurst, D. H.; Shirvington, P. J.; Heuer, P. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Nucl. Mater.; 46: No. 1, 53-76(Feb 1973).

The aqueous oxidation of a selection of zirconium alloys has been studied under conditions relevant to those in water-cooled reactors. The out-of-reactor oxidation rates for etched specimens were found to be sensitive to the oxygen overpressure. Very high in-reactor rates of oxidation were found at high oxygen overpressures irrespective of the surface preparation technique used. The conditions used for pre-oxidation were also found to have an important influence on the subsequent corrosion rate. Pronounced "memory" effects were observed. Evidence is presented which suggests that the oxide produced under conditions of accelerated oxidation in pressurized water (i.e. at high oxygen overpressures, and in the presence of radiation or fluoride) although resembling "pre-transition" oxide, is actually far less protective than the oxide produced in deoxygenated water. It is suggested that "radiation-enhanced" oxidation of zirconium alloys is due to the formation of less protective oxide in the presence of radiolytically produced oxygen and fast neutron radiation. (12 figures, 50 references) (auth)

17809 SELECTIVE DISINTEGRATION OF ALUMINIDES OF THE TYPE $MeAl_3$ IN SOLUTIONS OF ALKALI. Aleikina, S. M.; Marshakov, I. K.; Tutukina, N. M.; Rechkin, V. N. (Voronezh State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 1, 62-65(1973). (In Russian).

The disintegration of aluminides of the transition metals was measured in NaOH solutions ranging from 0.1 to 5.0 M and the results suggested a separation of the aluminides into two groups. $NiAl_3$, $FeAl_3$, and $CuAl_2$ were characterized by the dissolution only of Al, leaving the transition metal to rearrange into its natural phase on an intermediate phase. In contrast, $TiAl_3$, $ZrAl_3$, and VAl_3 decomposed in alkali with the oxidation of both components; the Al predominantly dissolved, and the other metal aggregated on the surface in the form of the oxide. Thermodynamic parameters of the pure metals could be used to predict the corrosive attack of $MeAl_3$ type aluminides by alkali solutions. (KSW)

17810 OXIDATION OF CHROMIUM-3 W/O THORIA. Wright, I. G. (Battelle-Columbus Labs., Ohio); Stringer, J. Metallography; 6: No. 1, 65-83(Feb 1973).

The mode of oxidation of a Cr–3 wt % ThO_2 alloy at 1100°C in 100 torr oxygen was investigated and the scale morphologies

examined using a scanning electron microscope. The scale structures are very different from those associated with unthoriated chromium, and the sequence of events leading to the production of the various structures is described. It appears that while the scale is largely detached from the alloy at temperature, as is the case with unthoriated chromium, oxygen transport through the scale may play an important role in determining the morphological features of the thoriated alloy. (auth)

17811 EVALUATION OF PROTECTIVE COATINGS FOR PREVENTION OF CORROSION OF HIGH STRENGTH STEELS WHEN SUBJECTED TO EXTREME ENVIRONMENTS. Deatherage, J. H. SAMPE Quart.; 4: No. 2, 5-9(Jan 1973).

As a result of corrosion problems encountered during the development of the Dragon Weapon System, an extensive study to evaluate various protective coatings has been completed. Several coatings were selected as potential candidates for a protection system to be used on a marage steel rocket motor case. Each of the coatings were subjected to various tests to determine their ability to prevent corrosion of the steel structure when subjected to high humidity, salt fog, tap-water immersion, and salt-water immersion. Testing techniques are discussed and critiqued as to their effectiveness and cost. (auth)

17812 OXIDATION OF TANTALUM AND NIOBIUM IN THE TEMPERATURE RANGE 400 TO 600^{0}C. McKee, I.; Wallwork, G. R. (Univ. of New South Wales, Kensington, Australia). J. Less-Common Metals; 30: 249-258(1973).

Metallographic methods have been primarily used for studying the mechanism of oxidation of tantalum and niobium in the temperature range 400 to 600°C. In order to explain the mechanisms, it is necessary to invoke a process which can account for the sudden transitions in the kinetic curves, the temperature inversion at approximately 600°C, the rather marked pressure effects over a large section of the temperature range and the presence of the suboxide phases in the metal beneath the scale. It is suggested that the formation of a suboxide in the metal phase by a martensitic transformation is of prime importance. This transformation induces excessive stresses in the already highly stressed metal lattice causing exfoliation of thin pieces of metal from the metal surface. The further oxidation of these thin slivers of metal is then responsible for the extremely high rate of oxidation. (auth)

17813 ION MICROPROBE MEASUREMENTS OF CONCENTRATION DEPTH PROFILES OF ERBIUM OXIDE ON THIN FILM ERBIUM METAL. Guthrie, J. W. (Sandia Labs., Albuquerque, NM). J. Less-Common Metals; 30: 317-320(1973).

Relative concentration depth profiles of erbium oxide associated with the surface of vacuum-annealed thin-film erbium metal were measured, using an ion microprobe mass analyzer. It is noted that the same technique can be used to obtain profile information at an erbium thin film/substrate interface. (auth)

Preparation and Fabrication

Refer also to abstract 17785.

17814 (BARC-612) PREPARATION OF ZIRCONIUM–NIOBIUM ALLOY BY CARBIDE–OXIDE REACTIONS. Venkataramani, R.; Garg, S. P.; Sundaram, C. V. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 16p. Dep. NTIS (U. S. Sales Only).

This investigation is concerned with the direct preparation of Zr–Nb master alloys by reaction between ZrC and Nb_2O_5. The thermodynamics of the reaction are discussed. Starting with two different compositions corresponding to 5% and 15% excess oxygen over the stoichiometric requirements, and adopting progressive heat soaking under high dynamic vacuum, followed by electron beam melting, zirconium–niobium alloys low in carbon and oxygen were prepared. The influences of initial oxygen excess and time of heat soak on the final purity of the alloy were examined. The overall material balance for the reaction indicates removal of oxygen both through carbothermic reduction (as CO) and through sacrificial deoxidation (as ZrO). (auth)

17815 (ORNL-4830) ORNL AUTOMATED ORBITAL PIPE WELDING SYSTEMS. Holz, P. P. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 52p. Dep. NTIS.

An improved automated welding system that has demonstrated reliable performance in making nuclear-quality welds on pipes from 3 to 16 in. in outside diameter is described. The equipment consists of an orbital horseshoe-shaped carriage that clamps onto a pipe and propels the welding apparatus around the circumference of a pipe in conjunction with an automatic welding programmer–controller that constantly maintains all conditions necessary to produce code-quality welds. The automated system has demonstrated that it can consistently produce high-quality welds, which also makes it attractive for direct welding applications in the construction of nuclear plants. To this end, development efforts were expanded to include pipe welding with the joint geometries most commonly used in the construction of stainless steel and carbon steel piping systems. Procedures were developed and shown to give good results for construction welding of pipe joints fitted with a consumable weld insert ring placed in the gap of the open pipe butt joint. (JRD)

17816 RIPENING OF Sn–Cd EUTECTIC MICROSTRUCTURES. Racek, R.; Lesoult, G. (Ecole des Mines de Paris, Corbeil, France). J. Cryst. Growth; 16: No. 3, 223-226(Dec 1972).

A study of the effect of a controlled anneal on Cd–Sn eutectic lamellar structures shows that as-solidified features may be modified by a natural heat treatment during directional solidification. A simple model and experimental results indicate that modification is more important for rapidly solidified structures, with a low-temperature gradient. (auth)

17817 WHISKER AND ISLAND GROWTH OF CADMIUM ON (211) GERMANIUM. Voorhoeve, R. J.; Carides, J. N. (Bell Telephone Labs., Murray Hill, NJ). J. Cryst. Growth; 16: No. 3, 195-202(Dec 1972).

Depending on the heat treatment of the substrate, the deposition of cadmium on (211) germanium crystals leads to the nucleation and growth of islands or of whiskers. Whiskers as well as islands grew in ultrahigh vacuum, under conditions which effectively excluded mobile impurities. The growth of whiskers rather than islands is induced solely by the properties of the substrate surface. Dislocations in the germanium have no effect. Mechanisms of whisker growth depending on gas-phase diffusion or on impurities collected on the whiskers during growth are clearly inoperative in the present experiments. The kinetics of whisker and island formation are compared, using a molecular-beam mass-spectrometric technique. The kinetic data show that whiskers grow on heterogeneities on the substrate induced by the heat treatment. The whiskers are single crystals, with the growth direction likely to be [1212]. (auth)

17818 APPLICATION OF AMERICIUM–ALUMINUM ALLOYS FOR THE PRODUCTION OF TRANSURANIUM NUCLIDES AND METHOD FOR THE PRODUCTION OF AMERICIUM–ALUMINUM ALLOYS. Wede, U. (to Gesellschaft fuer Kernforschung mbH). German Patent 2,051,923. 27 Apr 1972. 8p. (In German).

A method for the preparation of an americium–aluminum alloy is proposed which is a particularly suitable target material for the production of transuranium nuclides (e.g., CF-252) via neutron irradiation. An americium compound (AmO_2), to which a fluxing agent was added, is reduced with aluminum in a melt and converted to an americium–aluminum alloy. The reduction is performed in a graphite crucible at a temperature between 900 and 1,200°C. In order to separate the aluminum compound from the fluxing agent as well as to achieve a rapid solidification, the alloy is cast into a mold. (GF)

17819 METAL FORMING: INTERRELATION BETWEEN THEORY AND PRACTICE. Proceedings of a Symposium Held In Cleveland, Ohio, October 1970. Hoffmanner, A. L. Metallurgical Society of AIME Proceedings. New York; Plenum Publishing Corporation (1971). 515p. (CONF-701075).

Twenty-one papers were presented at the symposium. A separate abstract was prepared for each of five papers selected as being in the scope of NSA. (JRD)

For abstracts of individual papers see: 17820–17823, and 17847.

17820 APPLICATION OF THE AVITZUR UPPER BOUND EQUATION TO TUNGSTEN WIRE DRAWING AND ITS USE IN DIE-LINE DESIGN. Mullendore, J. A. (Sylvania Electric Products Inc., Towanda, PA). pp 235-248 of Metal Forming: Interrelation Between Theory and Practice. Hoffmanner, A. L. (ed.). New York; Plenum Publishing Corp. (1971).

From Symposium on Metal Forming and Interrelation Between Theory and Practice; Cleveland, Ohio, United States of America (USA) (21 Oct 1970). See CONF-701075–.

Draw-force measurements were made for W and W–3.25% Re wires drawn on a variety of die lines with a reduction in area per pass varying from 5 to 50% and a draw speed of 12 to 16 ft/min. The flow stress after each pass was determined by tensile testing. A comparison of the experimental data with the results of a draw force analysis based on the Avitzur upper bound equation shows that this calculation gives a die line that is close to the standard die line and permits a more quantitative evaluation of the wire-drawing process than has been possible previously. (Metals Abstr.)

17821 ANALYSES OF DEFORMATION AND TEXTURE AS FUNCTIONS OF FABRICATION IN MANDREL-DRAWN TUBING. Hobson, D. O. (Oak Ridge National Lab., TN). pp 199-213 of Metal Forming: Interrelation Between Theory and Practice. Hoffmanner, A. L. (ed.). New York; Plenum Publishing Corp. (1971).

From Symposium on metal forming and interrelation between Theory and Practice; Cleveland, OH (21 Oct 1970). See CONF-701075.

Zircaloy tubing was mandrel extruded from 4-in.-dia hollow billets, then tube reduced and drawn to finished size by schedules incorporating various amounts of ironing and sinking. Textures were determined after each pass by x-ray examination of specimens taken from the outer and inner surfaces and the midwall. It is shown that textures in this tubing can be predicted from the deformation process. For example, drawing schedules that are moderately ironing in nature produce large amounts of sinking deformation in the inner layers of the tube wall. The analysis should be helpful in improving the mechanical properties of Zircaloy tubing used as cladding for the UO_2 pellet fuel in light-water power reactors. (Metals Abstr.)

17822 FORCE REQUIREMENTS AND FRICTION IN WARM WORKING OPERATIONS. Berry, J. T.; Pope, M. H. (Univ. of Vermont, Burlington). pp 307-324 of Metal Forming: Interrelation Between Theory and Practice. Hoffmanner, A. L. (ed.). New York; Plenum Publishing Corp. (1971).

From Symposium on Metal Forming and Interrelation Between Theory and Practice; Cleveland, Ohio, United States of America (USA) (21 Oct 1970). See CONF-701075-.

Results of investigations concerned with back extrusion of low-alloy steels in warm working ranges are discussed along with results obtained in experiments involving fracture cup drawing in Ti-base and Ni-base materials. Comparisons between the theoretical and experimental results for warm back extrusion demonstrate the need for meaningful flow stress data for the warm-working range. The investigation into warm cup drawing shows the importance of using friction data obtained with the correct workpiece-tool combination, at the correct temperature and under conditions of bulk plastic deformation. Results of the two investigations have shown the feasibility of utilizing the warm-working range with a variety of material-lubricant combinations. (J.R.D.)

17823 SIMULATION OF EXTRUSION STRUCTURES BY MEANS OF TORSION TESTING FOR A HIGH STRENGTH NICKEL-BASE ALLOY, UDIMET 700. Young, C. M.; Sherby, O. D. (Stanford Univ., CA). pp 429-451 of Metal Forming: Interrelation Between Theory and Practice. Hoffmanner, A. L. (ed.). New York; Plenum Publishing Corp. (1971).

From Symposium on Metal Forming and Interrelation Between Theory and Practice; Cleveland, Ohio, United States of America (USA) (21 Oct 1970). See CONF-701075-.

Research devoted to evaluate the working properties and extrusion of Udimet 700 is described. Microstructures of hot-worked Udimet 700 were also studied. It was found that microstructures of U-700 developed in extrusion could be simulated by means of the torsion test in the temperature range of 1050 to 1150°C. At each temperature in the hot working range a distinctive structure was developed which could be characterized by optical microscopy. The microstructures developed in torsion seem to be the result of recrystallization during deformation and after a strain of approximately 2.0 the structure appears to become independent of strain. The original longitudinal texture present in the billet material is sheared and a new texture develops on radial planes at large strains in torsion. Hot working of U-700 appears to involve repeated recrystallization. This is manifest in the shape of the stress-strain curve which shows a strain softening leading to a steady state flow stress and by the difference in grain size between the deformed and nondeformed sections of the same as-quenched sample. The ductility versus temperature curves for U-700 clearly defines the optimum hot working range of temperature and strain rates for this alloy and serve as an example of the usefulness of the torsion test to predetermine working parameters. (JRD)

17824 EXPERIENCE WITH AN ELECTRON BEAM VAPOR SOURCE FOR METALS AND ALLOYS WITH HIGH MELTING POINTS. Langer, H. D. Wiss. Z. Tech. Hochsch. Karl-Marx-Stadt; 12: No. 5, 605-612(1970). (In German).

The experience gained by operation of an electronically stabilized electron source for the production of layers of high melting-point metals and alloys is discussed, using Ta as an example. Because of the ultrahigh vacuum in the equipment, the gas content of the layers is controlled. (22 references) (Metals Abstr.)

17825 PHASE TRANSFORMATION IN THE TITANIUM ALLOY Ti-6Al-4V. Modin, H.; Modin, S. Jernkontorets Ann.; 155: No. 8, 425-428(1971).

The structures obtained by different treatments of Ti-6Al-4V are difficult to interpret. In optical micrographs both light and dark plate-like transformation products appeared against the matrix, which on high magnification under scanning microscope seem to consist of a matrix with fine precipitates. Thin foils were examined under the electron microscope at -50°C to study the finely divided reaction products after etching. Details on heat treatment and precipitate correlation are given. (Metals Abstr.)

17826 1971 FALL POWDER METALLURGY CONFERENCE PROCEEDINGS. Proceedings of a Conference Held in Detroit, Michigan, October 19-21, 1971. Mocarski, S. (ed.). New York; Metal Powder Industries Federation (1972). 322p. $35.00. (CONF-711063).

Twenty-three papers were presented at the conference. A separate abstract was prepared for each of three papers selected as in the scope of NSA. (JRD)

For abstracts of individual papers see: 17827, 17828, and 17861.

17827 COMBINED STRESS-STATE (TRIAXIAL) COMPACTION FOR IMPROVED GREEN PROPERTIES. Koerner, R. M.; McCabe, W. M. (Drexel Univ., Philadelphia). pp. 267-279 of 1971 Fall Powder Metallurgy Conference Proceedings. Mocarski, S. (ed.). New York; Metal Powder Industries Federation (1972).

From 1971 Fall Powder Metallurgy Conference Proceedings; Detroit, Michigan, United States of America (USA) (19 Oct 1971). CONF-711063-.

Although widely used, die compaction is limited to the production of P/M parts with small height/diameter ratios. This is because of friction developed along the walls of the die that results in a significant density gradient within the compact. This problem is avoided when isostatic compaction is used. Thus, large parts, billets and preforms can be formed that have sufficient green strength for subsequent processing. However, other approaches that produce still higher green properties are of primary interest in the production of structural shapes. A technique has recently been developed that utilizes isostatic pressure and superimposed axial loads to effect compaction. The associated shear stresses produce mass particle reorientation resulting in a major increase in both green density and green strength over that obtained by standard isostatic pressing or die compaction alone. The generality of this triaxial (combined stress state) compaction method has been proved on a wide variety of metal powders (aluminum, iron, copper, nickel, and tungsten), and for a broad spectrum of particle characteristics (size, size distribution, shape, and production process). The technique is discussed in light of green density, green strength, pore structure, and the effect of stress-path on compact properties. (auth)

17828 FABRICATION OF HASTELLOY B SHEET BY POWDER METALLURGY USING BLENDS OF ELEMENTAL POWDERS AND HOMOGENIZATION/DEFORMATION PROCESSING. Heckel, R. W.; Erich, D. L. (Drexel Univ., Philadelphia). pp 281-298 of 1971 Fall Powder Metallurgy Conference Proceedings. Mocarski, S. (ed.). New York; Metal Powder Industries Federation (1972).

From 1971 Fall Powder Metallurgy Conference Proceedings; Detroit, Michigan, United States of America (USA) (19 Oct 1971). CONF-711063-.

Powder-fabricated Hastelloy B sheet (Ni-28Mo-5Fe) was produced on a laboratory scale using compacted blends of elemental powders and homogenization/deformation processing. The deformation was carried out by rolling at room temperature. Processing routes were established on the basis of calculations of the kinetics of homogenization by solid-state interdiffusion; rolling was used to accelerate the homogenization process and to achieve fully dense sheet. Total processing times at 1200°C of 4 hours were sufficient to produce homogeneous sheet using 5-μ size powders. Both mechanical properties and corrosion resistance (in boiling 20% HCl) were essentially the same as those of commercially available Hastelloy B sheet produced by conventional cast-and-wrought processing techniques. Three additional alloys Ni-20Mo, Ni-28Mo, and Ni-20Mo-4Fe were prepared by powder-metallurgy processing for comparison with the prepared Hastelloy B. (auth)

17829 PROPERTIES OF Mo-C, Mo-Zr-C, AND Mo-Ti-C WELD JOINTS. Alekseenko, G. N. (Inst. of Electric Welding, Kiev); Nerodenko, M. M.; Biryukova, T. A.; Mal'tsev, M. V.;

Shchukin, A. A. Avtomat. Svarka; No. 9, 20–22(Sep 1972). (In Russian).

The effect of zirconium and titanium on the properties of weld joints for a molybdenum–carbon alloy was investigated. Ingots of the alloys were produced in an electron-beam furnace and rolled into sheet 1 mm thick. The sheets were welded using a tungsten electrode in a controlled helium atmosphere. One heat of the Mo–C alloy contained 0.06% C (heat 1); two heats of the Mo–Zr–C alloy were made, one containing 0.04 wt % C, 0.16 wt % Zr (heat 2), the other –0.5 wt % C, 0.34 wt % Zr (heat 3); and two heats of the Mo–Ti–C alloy, one containing 0.05 wt % C, 0.014 wt % Ti (heat 4), the other—0.055 wt % C, 0.026 wt % Ti (heat 5). Alloying with Ti and Zr increased the weld joint ductility but reduced cold brittleness. Ti was less effective than Zr, which is probably associated with the fact that small additions of Ti increase solubility of carbon in Mo in the solid state or bond the carbon into carbides. Ti and Zr also increase strength of the weld joints and seam hardness. Both elements refine the seam metal structure and positively influence the structure of the heat-affected zone, diminishing the extent of the heat-affected zone and grain size near the fusion lines. In the study of weld-joint mechanical properties it was established that the alloys containing Ti failed primarily in the seam and that these alloys tend to form hot cracks during welding. In contrast to this, weld joints made from the Mo–Zr–C alloys undergo failure both in the seam and along the fusion lines. In summary, additions of Zr refine the structure of the seam metal and heat-affected zone, facilitate the formation of a substructure, and increase strength and ductility of the weld joints, while Ti additions have a lesser effect on the ductility of weld joints made using the Mo–C alloy. (JPRS)

17830 URANIUM SURFACE PREPARATION FOR ELECTROLESS NICKEL PLATING. Jacky, G. F.; Ehrlich, R. D. (to United States Atomic Energy Commission). U. S. Patent 3,700,482. 24 Oct 1972. Filed 1 Dec 1970.

The quality of nickel plating applied to uranium bodies by the electroless plating process is substantially improved, if after degreasing, pickling, and etching, the uranium bodies are treated with a saturated solution of palladium chloride or a hot solution of tetrasodium pyrophosphate and rinsed before immersion in the electroless nickel plating solution. (Official Gazette)

17831 EFFECT OF TEMPERATURE AND SPEED OF DEFORMATION ON THE COEFFICIENT OF EXTENSION OF THIN SHEET MOLYBDENUM AND ITS ALLOYS. Korolev, V. N.; Galakhov, A. I. Kuznechno-Shtampovochnoe Proizvod.; No. 5, 15-18(May 1972). (In Russian).

The results of an investigation into the effect of temperature and speed of deformation on the pressing of thin sheets of Mo (MCh, dia 35 mm, thickness 0.8, 0.5, and 0.3 mm) and Mo alloys (TsM-2A and VM-1) are presented. Aqueous colloidal graphite lubricant (specification GOST 5245-50) was used. Recrystallization annealing is necessary after pressing. (Metals Abstr.)

17832 GENERAL RESISTANCE OF WELD SEAMS WITH A VIEW TO STRESS CORROSION CRACKING AND CORROSION FATIGUE. Grafen, H. Werkst. Korros.; 23: 527-537(1972).

The corrosion of welds is due to thermal effects during welding which give rise to structural changes and, frequently, compositional changes in the transition zone. The welded material is rapidly cooled and may thus be heterogeneous and may present residual stresses resulting in increased susceptibility to selective and stress corrosion. The manganese content is of high importance in low alloy steels, as well as residual martensite or austenite embedded in a ferrite matrix. Low-ferrite contents are generally beneficial because they counteract high-temperature cracking; however, ferrite contents should be kept below 10% in order to prevent the formation of a continuous network giving rise to selective corrosion. Corrosion susceptibility may also be produced by carbide or carbonitride precipitation in austenitic and ferritic steels and nickel-base alloys. Weld zones in aluminum alloys are attacked in rare cases (e.g., by HNO_3) and the susceptibility of Ta, Zr, and Ti depends on the properties of the protective atmospheres. (Corros. Abstr.)

17833 THREE-STEP METHOD FOR THE THERMAL TREATMENT OF PLASMA-CONSOLIDATED BERYLLIUM FOR THE PREPARATION OF HIGHLY DENSIFIED BERYLLIUM WITH A THEORETICAL DENSITY OF MORE THAN 99%. Taylor, T. A.; Baird, R. J. (to Union Carbide Corp.). German Patent 2,147,976. 20 Jul 1972. 33p. (In German).

A procedure for the thermal treatment of plasma-consolidated beryllium for preparing highly densified, mainly isotropic polycrystalline beryllium with excellent mechanical and physical properties is described. The plasma-consolidated beryllium is fed into a temperature-controlled gas-extruding desorption stage, followed by a temperature-controlled sintering stage. A cooling stage is included in which the distribution of the impurities in the Be is controlled by means of dissolving reactions and/or precipitation. (GF)

17834 ELECTROLYTIC PREPARATION OF VANADIUM FROM VANADIUM CARBIDE. Lei, K. P. V.; Campbell, R. E.; Sullivan, T. A. (Dept. of Interior, Boulder City, NV). J. Electrochem. Soc.; 120: No. 2, 211-215(Feb 1973).

The preparation of vanadium by molten-salt electrolysis of a commercial vanadium carbide (VC) containing 84% vanadium was investigated. An electrolytic process was developed for the extraction of vanadium from VC in an $LiCl–NaCl–VCl_2$ electrolyte contained in a helium-atmosphere cell at 650°C. The effects of electrolyte composition, vanadium depletion of the VC, and cathode current densities on the process, as well as the effects on the quality of vanadium products, were determined. Vanadium of 99% purity was prepared with an 85% recovery of vanadium and a cathode current efficiency of 70%. The vanadium contained approximately 0.60% oxygen and had a 100 Rockwell B hardness. High-purity, ductile vanadium was prepared from the VC by electrorefining the extraction products in a separate cell or by combining the extraction and electrorefining processes in a single cell. In the combined process, the vanadium was first extracted from the VC and deposited on a cylindrical electrode; this vanadium was then electrorefined and deposited on a central cathode rod. Both methods yielded vanadium of 99.9% purity with 35 to 40 Rockwell B hardness. With limited tests in the combined process, 58% recovery of ductile vanadium from the VC was achieved. (auth)

17835 PREPARATION OF SINGLE CRYSTALS OF $CeAl_2$ BY THE CZOCHRALSKI METHOD. Godet, M.; Walker, E.; Purwins, H. G. (Univ., Geneva). J. Less-Common Metals; 30: 301-302 (1973).

A polycrystalline ingot of $CeAl_2$ was prepared in a water-cooled silver boat from Ce and Al. The pure metals in the correct proportions for the stoichiometric composition were melted together by induction heating in argon at one atmosphere pressure. From one part of the resulting ingot a cylinder of 4-mm dia and 12-mm length was cut. This cylinder was annealed for 24 h at 1000°C and then attached to a molybdenum rod. The other part of the ingot was melted in a tungsten crucible heated by a single coil inductor fed by a 12-kW Philips high-frequency generator. To prevent the melt from evaporating an overpressure of one-third of an atmosphere of argon was maintained in the furnace during the pulling procedure. The temperature was controlled optically. The pulling velocity was 15 mm/h and the polycrystalline seed was rotated 10 turns per minute. The lower part of the resulting cylinder was monocrystalline after the first run. This part was finally cut along the (110) direction and in a second run the single crystal of $CeAl_2$ was pulled, which has a (110) axis along the axis of the cylinder. This crystal had a pycnometric density of 4.97 g/cm^3. (auth)

17836 PRODUCTION OF THORIUM BY REDUCTION OF ThO_2 BY LIQUID MAGNESIUM. Capocchi, J. D. T. Metalurgia (Sao Paulo); 27: No. 169, 881-890(Dec 1971). (In Portuguese).

Experimental runs were performed by a process for obtaining metallic Th (sponge) by reduction of ThO_2 by Mg dissolved in a liquid Zn–Mg alloy and separation of the Th from the resulting Zn–Mg–Th alloy by vacuum distillation. The influence of various concentrations of $MgCl_2$, CaF_2, and MgF_2 in a fused salt mixture and of other values is reported. Reduction efficiencies were always <15%. The low yields are attributed to the impurity and instability of the constituents of the fused salt mixtures, contamination of the primary alloy containing Th by the products of corrosion of the cast iron crucible and agitator and disproportionate molten metal/fused salt and ThO_2/fused salt ratios. The percentages of distillate in relation to the masses of primary alloy charged into the retort were little affected by time and temperature. The residues from the distillation phase did not have the expected Th contents, a max of 25.5% Th being obtained. 35 references. (Metals Abstr.)

Properties, Structure, and Phase Studies

Refer also to abstracts 17173, 17730, 17731, 17734, 17769, 17772–17774, 19037, 19038, 19087, and 19390.

17837 (IS-T-555) CONVECTION EFFECTS DURING ELECTROTRANSPORT OF LIQUID METALS. Shaw, R. E. (Ames Lab., Iowa). Nov 1972. Contract W-7405-eng-82. 54p. Dep. NTIS.

Thesis.

Convection during electrotransport in liquid metals is a well

known effect. Yet no satisfactory explanation of the convection mechanism is presently available. Caused by the presence of such convection are several deleterious results: 1) inability in reaching the high separations predicted; 2) inaccurate measurement of liquid-metal diffusion coefficients; and 3) incomplete understanding of one aspect of the theory of liquid metals. Literature reviews are presented on several theoretically proposed convection mechanisms and on several attempts to experimentally determine the relationship between convection and the driving force for electrotransport. On the basis that no general agreement has been reached in the several experimental studies, a series of measurements using the four-probe capillary reservoir technique are made of the effective diffusion coefficient of Cd in dilute amalgams. Numerous current densities, j, and capillary radii, a, are used and several statistical analyses of the data are carried out in order to check the parametric dependence of convection on j and a. None of the proposed mechanisms, or combination of them, is as successful in explaining the results as is a model containing only a j^2a^4 dependence. Since no mechanism containing this dependence is present in the literature, it can only be said that in order to minimize convection during electrotransport the smallest practical radius capillary should be used so that j may be large enough to lead to relatively rapid processes. (87 references) (auth)

17838 (KFK-1680) AGE HARDENING BEHAVIOR OF V–Ti, V–Ti–Si, V–Zr, AND V–Hf ALLOYS WITH REFERENCE TO THE METALLOID N, O, B, AND C. Scholz, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut Fuer Material Und Festkoerperforschung). Sep 1972. 40p. (In German). Dep. NTIS (U. S. Sales Only).

An investigation was performed to determine the influence of N, O, B, and C on the precipitation- and age-hardening-behavior of the alloys V–Ti, V–3Ti–Si, V–2Zr, and V–1Hf. The purpose of this study was to investigate what effect these interstitials have on the age-hardening processes and whether this effect has to be taken into account for fuel element cladding. Possible new applications for age-hardened vanadium alloys outside of the nuclear field were evaluated. The alloys V–Ti–O and V–Hf–C showed an increase in hardness after temperature treatments. A high carbon content in the alloy V–Ti–O prevents age hardening. Age hardening was increased by additions of boron and silicon. The age-hardening processes can be used for a possible improvement of the creep strength to temperatures up to 750°C, since above this temperature averaging occurs after a short time. In order to avoid a too-high resistance to deformation during the extrusion of V–Ti–O alloys, the extrusion temperature has to be higher than 800°C. New fields of application for vanadium-base alloys beyond nuclear engineering were not found. (auth)

17839 (RD/B/N-2396) VOID NUCLEATION DURING THERMAL CYCLING OF ADJUSTED URANIUM. Lobb, R.C. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Nov 1972. 17p. Dep. NTIS (U.S. Sales Only).

The nucleation of voids in adjusted uranium was studied during thermal cycling within the α phase and during rapid quenching from the β phase. Voids were observed to nucleate intragranularly at carbide inclusion/matrix interfaces before subsequent void growth occurred intergranularly. A model for void nucleation is proposed, based upon the differential thermal expansion of the inclusion and surrounding matrix. (auth)

17840 (TID-26251) VOLUMETRIC EXPANSION OF SILVER ALLOY. Droege, J. W. (Battelle Columbus Labs., Ohio). 3 Nov 1972. 5p. Dep. NTIS.

Results of measurements of density and linear expansion of Ag–15% In–5% Cd rods at room temperature to the melting range are presented. Data are presented graphically and discussed. (JRD)

17841 (WAPD-TM-1077) MICROSTRUCTURAL OBSERVATIONS ON NICKEL–CHROMIUM–IRON ALLOY 718. LWBR Development Program. Towner, R. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.) Jan 1973. Contract AT(11-1)-GEN-14. 77p. Dep. NTIS.

Characteristic microstructures of sheet, wire, and bar are presented, as influenced by material processing conditions and as revealed by various metallographic techniques. The conditions and techniques described result from development work on NiCrFe Alloy 718 in conjunction with the LWBR Development Program. The amount of niobium carbide precipitate at grain boundaries after aging appeared to be strongly influenced by solution annealing temperature and relatively small differences in chemical composition. Fine precipitate was observed at grain boundaries after 1860°F braze/heat treatment. During the 1800 to 1860°F solution anneals, recrystallization and/or grain growth moved the grain boundaries from prior carbide networks, and coarse grains in duplex structures in bar underwent a refinement of grain size through recrystallization. (auth)

17842 STRUCTURAL STATES OF ALLOYS OF Cu–Be–Ag DURING THE DECOMPOSITION OF A SOLID SOLUTION. Zakharova, M. I.; Kao Min Ti; Smirnov, Yu. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 21-25(1972). (In Russian).

Aging of the two alloys Cu–1.5% Be–2% Fe and Cu–1% Be–4% Ag was investigated by x ray study of the single crystals and by electron microscopy. During aging at 218, 300 and 450°C laminated zones were formed which were enriched in Be and Ag. The entry of Ag into the zone broadened the upper temperature interval of the zone phase up to 450°C. With increase in the annealing time a metastable γ'-phase separated and was oriented in the ⟨100⟩ direction as a result of fields of elastic tension. The fields arose near the γ' separation and a periodic structure was formed in the alloy. The equilibrium phase γ-CuBe in Ag separated from the alloy Cu–1% Be–4% Ag. (tr-auth)

17843 REDKOZEMEL'NYYE METALLY I IKH TUGOPLAVKIE SOEDINENIYA (RARE EARTH METALS AND THEIR REFRACTORY COMPOUNDS). Gordienko, S. P.; Fenochka, B. V.; Fesenko, V. V. Kiev; Naukova Dumka Press (1971). 168p.

This book studies the evaporation of rare earths, Sc, Y, and their compounds. The six chapters cover, respectively: methods for studying the evaporation, rare earth metals, rare earth oxides, carbides, borides, and other refractory compounds (particularly chalcogenides). A bibliography is provided at the end of each chapter. (DLC)

17844 ALLOYS FOR PRECISION RESISTORS. Kukhar, V. V. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 413-18(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 41-6(May 1972).

A review is presented of the electrical properties (resistivity, temperature coefficients, and thermo-emf in couple with Cu) of manganin (Cu–Mn) and other electrical resistance alloys (which include In, W, Mo, and V alloys). Means for lowering the temperature coefficient of resistance and the thermo-emf are discussed. Optimum heat treatment is considered. (27 references) (DLC)

17845 METALLOGRAPHIC ORIENTATION DETERMINATIONS ON HEXAGONAL POLYCRYSTALS WITH THE AID OF QUANTITATIVE POLARIZATION EQUIPMENT OF THE NEOPHOT. Reh, Burkhard; Simmen, Burckhard (Freiberg i. B. Mining Academy). Jena Rev.; No. 5, 250-254(1972).

A method is described that permits rapid and relatively exact orientation determination of single crystallites of optically uniaxial metals, which should have a diameter of at least 20 to 30 μm. It affords, in addition, a quick survey of the structural state of such materials. The application of this method to polycrystalline magnesium and magnesium-cadmium revealed a good agreement with the results of radiographic orientation determinations. (auth)

17846 ELECTRON-STIMULATED DESORPTION OF IONS AND EXCITED NEUTRALS: CARBON MONOXIDE ON TUNGSTEN. Newsham, I. G. Pullman, WA; Washington State Univ. (1972). 76p. University Microfilms Order No. 73-67.

Thesis (Ph. D.).

The desorption of excited neutrals and ions by low-energy electron interaction with a carbon monoxide layer on a (100) single-crystal tungsten surface is studied by a time-of-flight technique. This method allows the detection of the metastables without interference from photons emitted from the surface. Energy distributions, approximate threshold energies, adsorption kinetics, and effects of heating and heavy electron bombardment are presented for the excited neutrals, CO^+, and O^+ ions in the temperature range 110 to 740°K. As the binding state producing the excited neutrals was observed to be identical to the CO^+-producing state, the excited neutrals are most likely CO molecules. A simple one-dimensional model is presented describing a shift in the O^+ ion energy distribution. (Diss. Abstr. Int., B)

17847 USE OF WORKABILITY TEST RESULTS TO PREDICT PROCESSING LIMITS. Hoffmanner, A. L. (TRW Inc., Cleveland). pp 349 -391 of Metal Forming: Interrelation Between Theory and Practice. Hoffmanner, A. L. (ed.). New York; Plenum Publishing Corp. (1971).

From Symposium on Metal Forming and Interrelation Between Theory and Practice; Cleveland, OH (21 Oct 1970). CONF-701075.

The concept of workability testing was developed from accurate determinations of the states of stress under which a material is deformed during testing. These results provided a general relationship between stress and fracture strain from a variety of tests and materials over a wide range of stress, strain rate, and tem-

perature. It was found that the major stress parameter determining the fracture strain $\bar{\epsilon}_f$ was the average value of the normal stress σ_T perpendicular to the direction of alignment of grain boundaries and second-phase particles. This definition of stress provided the ductile fracture criterion $\ln\bar{\epsilon}_f = A + B\,\sigma_T/\bar{\sigma}$, in which $\bar{\sigma}$ is the flow stress and A and B are material parameters related to the mechanical behavior of the solid solution and mechanical texturing, respectively. The workability concept subsequently was amplified by applying the test results to make accurate predictions of working limits during forging, extrusion, and rolling. Good agreement was found between predictions and observations when the mechanics of the processes were defined by analytical and experimental–analytical procedures. These results will be extended to support qualitative procedures for process improvements by isolating the factors most prominent in determining the limiting reductions during deformation processing. (auth)

17848 CREEP BEHAVIOR OF HIGH-NICKEL AND -CHROMIUM STAINLESS STEELS FOR FAST BREEDER REACTORS. Lagneborg, R.; Oestberg, G.; Attermo, R. Jernkontorets Ann.; 155: No. 9, 601-609(1971).

The optimum compositions as regards Ti and C levels in 19:25 and 19:34 Cr–Ni austenitic stainless steels with specific requirements on creep properties were assessed and compared with Sandvik steel 12R72HV containing Cr 15% –Ni 15% –Ti 0.5% –B–Mo. The composition variables were: B 50-100 ppM, Ti:C in different proportions. Maximum creep strength was obtained at 1% Ti level, but the scatter in strength was large. The creep ductility of these steels was quite high. (27 references) (Metals Abstr.)

17849 THERMODYNAMIC STUDY OF THE IRON–MOLYBDENUM–CARBON SYSTEM AT 1000°C. Nishizawa, T. Scand. J. Met.; 1: No. 1, 41-48(1972).

The Fe–Mo–C system was investigated at 1000°C using the sealed capsule technique and microprobe analysis; phases were identified by optical microscopy and Debye–Scherrer x-ray examination. Thermodynamic data from the literature were evaluated and the isoactivity lines for C and the solubilities of each carbide in the austenite at 1000°C were calculated. The isothermal section at 1000°C is derived. (20 references) (Metals Abstr.)

17850 SELF- AND SOLUTE-DIFFUSION IN DILUTE ZIRCONIUM–NIOBIUM ALLOYS IN β-PHASE. Tiwari, G. P.; Sharma, B. D.; Raghunathan, V. S.; Patil, R. V. (Bhabha Atomic Research Centre, Bombay). J. Nucl. Mater.; 46: No. 1, 35-40 (Feb 1973).

Diffusion of ^{95}Zr and ^{95}Nb isotopes was investigated in zirconium–1% niobium and zirconium–3% niobium alloys in the temperature range 900 to 1200°C, using the residual-activity technique. The studies revealed that (i) over this small temperature range log D vs 1/T plots are linear, (ii) addition of niobium causes self- and solute-diffusivity enhancement, and (iii) the data can be analyzed in accordance with Lidiard's theory for diffusion in dilute alloys. The analysis of results showed that the correlation factor for diffusion of niobium in β-zirconium is 0.92. This value is in agreement with the value predicted for slow diffusers. (30 references) (auth)

17851 GRAIN-BOUNDARY DIFFUSION OF TRITIUM IN 304- AND 316-STAINLESS STEELS. Calder, R. D.; Elleman, T. S.; Verghese, K. (North Carolina State Univ., Raleigh). J. Nucl. Mater.; 46: No. 1, 46-52(Feb 1973).

Grain-boundary diffusion of tritium in 304- and 316-stainless steel was studied over the temperature range –78°C to 185°C through direct measurement of tritium concentration profiles. Tritium was injected through transmutation of a surface blanket of ^{6}LiF, specimens were heated isothermally to establish a tritium diffusion gradient, and the specimen layers containing the rapidly diffusing grain boundary component were removed with a lathe and/or electropolishing. The data were analyzed by both Fisher's and Suzuoka's models for grain boundary diffusion and similar diffusion coefficients were obtained. Grain boundary diffusion coefficients (G) and their standard deviation are given by:

(Fisher) $G = \exp(8.85 \pm 1.2) \times \exp(-0.45 \pm 0.03\ \text{eV/kT})\ \text{cm}^2 \cdot \text{sec}^{-1}$,

(Suzuoka) $G = \exp(8.55 \pm 0.85) \times \exp(-0.43 \pm 0.02\ \text{eV/kT})\ \text{cm}^2 \cdot \text{sec}^{-1}$. (auth)

17852 MANGANESE DIFFUSION IN ZIRCONIUM. Tendler, R. (Comision Nacional de Energia Atomica, Buenos Aires); Varotto, C. F. J. Nucl. Mater.; 46: No. 1, 107-109(Feb 1973).

The bulk diffusion of ^{54}Mn in α- and β-Zr was studied at 600 to 1200°C. Results give $D = 2.4 \times 10^{-3} \exp(-30{,}200/RT)\ \text{cm}^2/\text{s}$ in α-Zr, and $5.6 \times 10^{-3} \exp(-33{,}000/RT)\ \text{cm}^2/\text{s}$ in β-Zr. The mechanism is probably solute diffusion in interstitial form. (DLC)

17853 RECOVERY AND DUCTILITY OF α-PLUTONIUM. Merz, M. D.; Allen, R. P. (Battelle-Northwest, Richland, WA). J. Nucl. Mater.; 46: No. 1, 110-112(Feb 1973).

Results of an x-ray-diffraction study of recovery in deformed α-Pu are reported. Textured α-Pu and high-angle diffraction peaks were used. Deformation was carried out and line sharpening measured after holding at various temperatures up to 100°C. A ductility transition was also observed at 40 to 100°C which is dependent on strain rate. The increased ductility of fine-grained α-Pu is probably due to redistribution of stresses. (DLC)

17854 DETERMINATION OF THE DIFFUSION MOBILITY OF INERT GASES IN SOLID BODIES. Skorov, D. M.; Dashkovskii, A. I.; Zaluzhnyi, A. G.; Storozhuk, O. M. At. Energ. (USSR); 33: No. 6, 996(Dec 1972). (In Russian).

The diffusion mobility of inert gases in metals is frequently determined from the kinetics of their release from metal samples during annealing. A portion of such gas released is proportional to $t^{1/2}$, where t is the annealing time. The effect of grain size on the diffusion of, e.g., Xe in β- and γ-uranium, and the effect of diffusion along the grain boundaries are discussed. (KSW)

17855 RARE EARTHS: THE ENERGY STORING OR CONVERSION METALS. Cannon, J. G. Precis. Metal; 30: No. 7, 32-34 (Jul 1972).

The rare earth metals Y, Ce, La, Sm, and Pr are finding applications in alloys for permanent magnets, in superalloys with improved oxidation and corrosion resistance, in carbides, nitrides and sulfides, as pyrophorics and getters, in highly stable hydrides and in tonnage iron and steelmaking. A table lists the density, melting and boiling points, crystal structure, electrical resistivity, tensile strength, hardness, and other properties of these metals and mischmetal. (Metals Abstr.)

17856 HIGH-VOLTAGE ELECTRON MICROSCOPE STUDY OF SUBOXIDE FORMATION IN VANADIUM. Geiss, R. H.; Ladd, R. L.; Lawless, K. R. Jernkontorets Ann.; 155: No. 8, 454-456 (1971).

Electron microscopic studies of V suboxides were carried out using a jet of a 20% H_2SO_4 + 80% CH_3OH polishing solution with subsequent oxidation in an ultra-vacuum chamber injected with rated amounts of very pure (spectrally pure) O. A transition from fine micro-twinning to martensitic-type structures was observed as the oxidation time was prolonged. (Metals Abstr.)

17857 GENERAL EQUATION FOR THE SOLUBILITY OF OXYGEN IN LIQUID SODIUM. Noden, J. D. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 57-62(Jan 1973).

A correlation has been made of existing published data on the solubility of oxygen in liquid sodium using the least-squares method. Selected data of 217 individual analyses have been used to derive the solubility curve, described by the general equation $\log_{10}[O]_{\text{wt ppM}} = 6.1579$ to $2384.2/T(K)$. (auth)

17858 ZIRCONIUM AND HAFNIUM: METALS OF THE NUCLEAR AGE. IV. Refractory and Reactive Metals. Webster, R. T. Precis. Metal; 30: No. 6, 79-82(Jun 1972).

Physical and mechanical properties are tabulated for Zr, Zircaloy, Zr–Nb alloy, and Hf. Methods used in mineral processing, forging, rolling, annealing, swaging, extrusion, drawing, welding, and bending are described for both Zr and Hf. The metallurgy of Zr is then discussed, with emphasis on the effect of alloying elements acting as α stabilizers, β stabilizers or low-solubility intermetallic compound formers. (Metals Abstr.)

17859 SURFACE SELF-DIFFUSION OF METALS. Neumann, G.; Neumann, G. M. Diffusion Monograph Series, No. 1, 1972. Bay Village, OH; Diffusion Information Center (1972). 130p. (NP–19645).

Descriptions of available experimental methods associated with evaluation of data on diffusion parameters, activation energies and Arrhenius pre-exponential factors for metals are presented. The information is presented in sections on experimental techniques, experimental results, and theoretical considerations. (212 references.) (JRD)

17860 STRATEGIC IMPORTANCE OF TUNGSTEN IN THE DEFENSE INDUSTRY. Belous, W. T. (Teledyne, Glen Cove, NY). Progr. Powder Met.; 27: Pt. 1, 111-117(1971).

From Proceeding of the 1st Tutorial Seminar on P/M in Ordnance; Philadelphia, Pennsylvania, United States of America (USA), (2 Jun 1971).

See CONF-710659-.

It is noted that W is used in weapon system items such as WC armor-piercing shells, flechettes, anti-personnel mines, radar

systems, aircraft components, gyros, radiation shielding, flares and rocket nozzles. Aspects of world supply of W are discussed along with effects of stockpiling by the US. Properties of W and W compounds such as cemented carbides are reviewed. Uses of W in radioisotope powered energy conversion systems, in cutting tools, and in flares and rocket nozzles are also reviewed. (JRD)

17861 CHARACTERIZATION OF COMMERCIAL TITANIUM POWDERS. Lynch, R. F.; Aqua, E. N. (N L Industries, Inc., Hightstown, NJ). pp 217-244 of 1971 Fall Powder Metallurgy Conference Proceedings. Mocarski, S. (ed.). New York; Metal Powder Industries Federation (1972).

From 1971 Fall Powder Metallurgy Conference Proceedings; Detroit, Michigan, United States of America (USA) (19 Oct 1971). CONF-711063-.

Particle and bulk characteristics of ten commercial titanium powders, determined by a series of interrelated measurements, were used to evaluate the suitability of various types of Ti powders for P/M applications. The powders investigated were produced directly from titanium sponge and by the hydride–dehydride process. Bulk-powder characteristics measured were apparent density, tap density, flow behavior, specific surface area (BET method), average particle size, and particle size distribution, as determined by sieve analysis and optical microscopy. Particle shape and morphology (scanning electron microscopy) were determined as they relate to individual particles. Material characteristics were evaluated by a consideration of composition, particle microhardness, discrete particle density (air pycnometry), and metallographic observations. Results of powder characterization are correlated with measurements of compressibility, green density, and green strength on conventional-die-compacted specimens. A direct correlation between deformation constant and green strength points out the overriding importance of plastic deformation in achieving a high green strength during compaction. Comments are offered on the merits of each type of powder with respect to consolidation, sintering, final product properties, and on the effects of variations in powder characteristics between powders produced by similar techniques. (auth)

17862 NUCLEATION OF SIGMA PHASE IN A COMPLEX NICKEL-BASE SUPERALLOY. Billingham, J.; Lauridsen, J. (Fulmer Research Inst., Stoke Poges, Eng.). Metallography; 6: No. 1, 85-90(Feb 1973).

Nickel-base superalloys with high Ti contents have been developed for high resistance to hot salt-corrosion attack. The metallography of such alloys (nominal composition = Ni 15Cr 15Co 4Mo) with varying Ti/Al ratio is reported. Large amounts of sigma phase are formed preferentially around the Ni_3Ti platelet phase (Cr-enriched region). (DLC)

17863 YIELD POINT PHENOMENON IN A Be–Al COMPOSITE. Ericksen, R. H. (Sandia Labs., Albuquerque, NM). Scr. Met.; 7: 65-68(Jan 1973).

Unidirectional Be–Al composites were fabricated using Al foil and Be wire. The Be volume fraction was 0.50. Tensile testing showed that the composites exhibit a yield point at ~50,000 psi, and that a Lüders band (3.0% strain) propagates through the specimen, which is inclined ~45° to the tensile axis. At a crosshead speed of 0.02 in./min, the Lüders band velocity is 0.60 ± 0.15 in./min. The yield point was observed at 0.2 to 0.0002 in./min and at a temperature as low as –85°C. (DLC)

17864 NIOBIUM-FREE VANADIUM-BASE ALLOY WITH HIGH CREEP STRENGTH. Wincierz, P.; Ruehle, M.; Reddemann, B. H.; Boehm, H. O.; Schirra, M. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,758,397. Mar 1972. 7p. (In German).

A niobium-free vanadium-base alloy is developed with a high creep strength over long-time testing which is suitable as reactor construction material or fuel-element cladding tubes. The composition is of 0.1 to <2.8% (preferably 1 to 2.5%) titanium and/or zirconium and/or hafnium, the remainder vanadium containing carbon, nitrogen, and oxygen each between 100 and 1,500 ppM, the total however not exceeding 3,000 ppM as well as the smallest amounts of remaining metal impurities such as nickel, iron, chromium, copper. An alloy composition as the above mentioned with 400 to 1,000 ppM oxygen, 200 to 600 ppM carbon, and 200 to 600 nitrogen, containing impurities of ~300 ppM iron, nickel, chromium, and ~100 ppM copper has proved to be a particular advantage as regards long-time creep strength. The alloy hardly contains 0.1 to 2% (preferably 0.5 to 1.5%) silicon, and is superior to all present-known titanium-containing and niobium–titanium-containing vanadium-base alloys. (GF)

17865 TRITIUM DIFFUSION IN AUSTENITIC STAINLESS STEELS AND ZIRCALOY-2. Austin, J. H. Raleigh, NC; North Carolina State Univ. (1972). 119p. University Microfilms Order No. 73-1184.

Thesis (Ph. D.).

Tritium, a ternary fission product, is one of the principal radioisotopes released to the environment from nuclear power plants during normal operation. It is, therefore, desirable to gain a thorough understanding of the migration of tritium in the major cladding materials to better predict tritium levels in the primary coolant. Results of research are presented on the diffusion of tritium in types 304- and 316-stainless steels and Zircaloy-2 by measurements of tritium concentration profiles and tritium surface release rates. Tritium was initially injected into the specimens by transmutation of a surface blanket of ^6LiF. The concentration profiles were obtained by electro- or chemical-polishing layers from the samples and then radioassaying the solutions and their tritiated water distillates. The accuracy of the technique was confirmed by the direct measurement of the tritium recoil distribution in the materials. The concentration profiles showed three diffusion components: a surface trapping region approximately 5 μm thick, Region I; a normal bulk diffusion profile, Region II; and a rapid grain boundary diffusion component, Region III. Bulk diffusion coefficients were determined over the temperature range 25 to 222°C from the profile data of Region II for the stainless steels and Zircaloy-2. Apparent diffusion coefficients for the surface region were determined by fitting a two region diffusion solution to measured surface tritium release data. Two possible causes of the surface effect were considered: an oxide layer and helium-stabilized voids. It was shown that surface oxide films trap tritium. There was also some evidence that the helium which is injected along with tritium contributes to trapping, but conflicting interpretations of experimental results render its role in trapping unclear. A two region diffusion solution with trapping in the surface region was derived. The observed low diffusion coefficients in the surface region can influence tritium diffusion rates in cladding materials. A three region diffusion model for a fuel cladding was developed to enable prediction of tritium release from fuel pins but numerical calculations have not been made. (Diss. Abstr. Int., B)

17866 MEASUREMENTS OF THE SOLUBILITIES AND DERIVED THERMODYNAMIC PROPERTIES OF TUNGSTEN AND TANTALUM IN LIQUID THORIUM AND URANIUM. Ackermann, R. J.; Rauh, E. G. (Argonne National Lab., IL). High Temp. Sci.; 4: No. 6, 496–505(Dec 1972).

The solubilities of tungsten and tantalum in liquid thorium and uranium have been measured individually over approximately 900°K temperature ranges within the overall range 1600 to 2900°K. The sets of data expressed in terms of the mole fractions of W and Ta as log x_M vs T^{-1} approach linear behavior only at the lower temperatures; at higher temperatures the solubility curves acquire a positive curvature. The derived partial molar excess enthalpies and entropies tend toward but do not achieve regular solution behavior. The results are correlated with solubility parameters, and the effects of the solubility of W and Ta on measurements of other thermodynamic quantities for liquid actinide metals are predicted. (auth)

17867 ENTHALPY AND SPECIFIC HEAT OF MOLTEN VANADIUM. Berezin, B. Ya.; Chekhovskoi, V. Ya.; Sheindlin, A. E. (Inst. of High Temperature, Moscow). High Temp. Sci.; 4: No. 6, 478–486(Dec 1972).

The enthalpy of molten vanadium within the temperature range 2084 to 2325°K was measured by the mixing method using the induction heating of specimens in an electromagnetic "crucible" and a massive copper calorimeter with an isothermal envelope. The true temperature of molten specimens was determined from the brightness temperature and the spectral radiation coefficient of molten vanadium. The experimental results were approximated by the equation $H_T^0 - H_{298.15}^0 = -3776 + 11.043T$ (cal/g-atom K). From the enthalpy data, the specific heat of molten vanadium was determined: $C_p = 11.04 \pm 0.70$ (cal/g-atom K). An analysis of the errors involved was carried out. (auth)

17868 DIFFUSION DATA, VOLUME 6, NUMBER 4, 1972. Woehlbier, F. H. (ed.). Diffus. Data; 6: No. 4, 551–699(1972).

Information and data are presented on diffusion in solid metals and alloys, liquid metals and alloys, semiconductors, oxides, halides, ionic materials, and miscellaneous host substances. Cumulative author, subject and material indexes of volumes 1 through 6 are included. (JRD)

17869 TWINNING IN ZIRCONIUM SINGLE CRYSTALS DEFORMED AT ELEVATED TEMPERATURES. Tenckhoff, E. (Siemens AG, Erlangen, Ger.). Z. Metallk.; 63: No. 11, 729-734 (1972). (In German).

The twinning systems in zirconium single crystals compressed in a (1123) direction depended upon the temperature of deformation. For this orientation at 20°C, twinning of the type (1012) occurred. At 250 and 500°C, twins of the type (1122) were observed.

At 650 and 750°C, a new twinning system became operative, namely (1011). (GF)

17870 COMMUTATION OF KILOAMPERE-RANGE DIRECT CURRENTS BY LIQUID METALS. Boguslavskii, V. A.; Tolmach, I. M.; Yantovskii, E. I. Magn. Gidrodin.; No. 1, 153-154(1972). (In Russian).

The most promising system of liquid-metal commutator devices is created when the liquid metal within its closed container occupies the position required for the commutation of the electrical circuit. The absence of mechanical motion of solids reduces the wear and the noise. The devices may be classified as conductive and inductive systems. A more recent design is based on the use involving the suspension of ferromagnetic particles in the electrically conducting liquid. Experiments were carried out with an inductive system which moved the conductive liquid by interaction with a rotating magnetic field. The device consisted of a closed cylindrical vessel placed in the stator of an asynchronous driving mechanism. The vessel was formed by an external tube and an internal magnetic circuit coated with an aluminum oxide base insulating compound, and two copper electrodes. The vessel was partially filled with a liquid mixture of In, Ga, and Sn which under the effect of gravity broke the circuit. Application of the control tension at the stator, the parabolic shape of the liquid closed the circuit. Commutation experiments were carried out with the 220-V dc source "on" and "off" at 100, 200, 400, 600, 700, and 1000 A. In both positions arcs were repeatedly initiated. (TTT)

17871 IMPROVEMENTS IN THE FABRICATION OF FUEL ELEMENTS. (to Centre de Recherches Metallurgiques). Belgian Patent 782,079. 13 Apr 1972. (In French).

For the fabrication of fuel jackets for fast neutron reactors, an Fe-based alloy with $8\% \leq Cr \leq 25\% - 0\% \leq Ti \leq 7\%$ is proposed. The Fe has its usual impurities. The alloy contains, in addition, one or several of the following elements in the proportions indicated: Al (from 0% to 6%), V (from 2% to 7%), Si (from 2% to 7%), and Mo (from 0% to 3%). In addition one or more of the stable oxides Al_2O_3, MgO, TiO_2, and Y_2O_3 are dispersed in the metallic matrix in the proportion from 0 to 8%. (JSR)

17872 CREEP AND CREEP-RUPTURE PROPERTIES OF THE NUCLEAR FUEL CLADDING TUBES FOR FAST BREEDER REACTORS. Tanaka, C. (National Research Inst. for Metals, Tokyo); Yoshida, S.; Yachita, T.; Nagasaki, R.; Yuhara, S. I. Trans. Nat. Res. Inst. Metals (Tokyo); 13: No. 4, 193-201(Jul 1971).

As a basis for design and fabrication of experimental fast breeder reactors, creep-rupture tests under internal pressure and creep and creep-rupture tests under uniaxial tension were carried out on two kinds of domestic nuclear fuel cladding tubes of Type 316 stainless steel which were approximately 6% and 18% cold-drawn, respectively, at test temperatures of 550, 600, 650, and 700°C in unirradiated and atmospheric conditions. The results obtained are summarized as follows: The data for tubes under uniaxial tension showed a little greater creep-rupture strength for the 6% cold-drawn specimens and definitely greater creep-rupture strength for the 18% cold-drawn specimens as compared with earlier data. The creep-rupture strength of the 18% cold-drawn tubes was generally greater than that of the 6% cold-drawn tubes. However, the creep-rupture curves for the two kinds of tubes tended to approach each other when the temperature was raised from 600 to 700°C and the test duration was prolonged. The data for creep-rupture tests under internal pressure nearly agreed with those for uniaxial tension tests at stresses less than approximately 30 kg/mm², when the hoop stress of internally pressurized specimen was calculated by the mean diameter formula. (auth)

17873 OXYGEN DIFFUSION IN LIQUID GALLIUM AND INDIUM. Klinedinst, K. A.; Stevenson, D. A. (Stanford Univ., CA). J. Electrochem. Soc.; 120: No. 2, 304-308(Feb 1973).

A potentiostatic electrochemical technique was used to determine the diffusion coefficients of oxygen in liquid Ga and In, for temperatures between 750 and 950°C. The oxygen diffused radially outward in cylindrical samples contained in the bottoms of yttria-doped thoria and calcia-stabilized zirconia electrolyte tubes. The experimental results are expressed by the following equations: $D_0(Ga) = (3.68 \pm 0.42)\ (10^{-3})\ \exp\ (-8.37 \pm 0.25/RT)\ cm^2/sec$, and $Do(In) = (8.22 \pm 1.87)\ (10^{-4})\ \exp\ (-12.6 \pm 0.5/RT)\ cm^2/sec$. The large observed difference between the magnitudes of $D_0(Ga)$ and $D_0(In)$ is not predicted by current theories of impurity diffusion. (auth)

17874 THERMAL BEHAVIOR OF A PLASMA-HEATED TUNGSTEN PROBE IN THE PRESENCE OF TUNGSTEN VAPOR. Mobus, P. (Univ. of Quebec). J. Electrochem. Soc.; 120: No. 2, 216-223(Feb 1973).

A tungsten metal probe is heated in an argon plasma containing variable amounts of tungsten vapor. It is observed that the metal surface temperature substantially decreases when the vapor concentration increases in the gas. All other conditions being equal, the difference residing in the presence of metal vapor in the plasma, the introduction of about 0.7% vapor in the argon gas decreases the probe surface temperature by 18%, while the presence of 8% metal vapor decreases the surface temperature by 28%, the gas temperature around the probe surface being respectively 9000 and 10,000°K. An equation is found, showing the probe temperature variations in terms of the total tungsten particle concentration as well as the gas temperature immediately around the probe. A possible explanation is given for the phenomena observed which involves the existence of a protective shield of tungsten atoms and ions in equilibrium along the saturation vapor curve for tungsten. Also, the presence of solid condensed particles around the probe, with relatively low thermionic work function, may provide a protective, positively charged shield against positive ion bombardment of the probe. This interpretation is supported, to a certain extent, by the equation found. (auth)

17875 OBSERVATIONS ON THE INTERACTION OF TWINS WITH GRAIN BOUNDARIES IN Mo—35 AT. PERCENT Re ALLOY. Mahajan, S. (Atomic Energy Research Establishment, Harwell, Eng.). Acta Met.; 21: No. 3, 255-260(Mar 1973).

The crystallographic features of twins interacting with a sub-boundary and a high angle grain boundary and of substructures evolved around the interaction regions have been investigated in detail using transmission electron microscopy. In no case are micro-cracks observed at the intersections, and the stress build-up is prevented by deformation of the constituent crystals. Arguments for rationalizing the evolution of observed substructures are developed. (auth)

17876 REGULAR DEFECT STRUCTURES IN HIGH-ANGLE GRAIN BOUNDARIES. Loberg, B.; Norden, H. (Chalmers Univ. of Tech., Goteborg). Acta Met.; 21: No. 3, 213-218(Mar 1973).

The structure of high-angle grain boundaries in tungsten has been studied using field ion microscopy and electron microscopy. The observed linear defect structure is explained in terms of plane matching across the grain boundary; this model of relaxation across the interface is assumed to apply more generally. (auth)

17877 CHARACTERISTICS OF THE Mn_5Si_3-, $CaZn_5$-, AND $CeNi_3$-TYPE PHASES. Raman, A.; Ghassem, H. (Louisiana State Univ., Baton Rouge). J. Less-Common Metals; 30: 185-197(1973).

The Mn_5Si_3-type structure occurs in the high-temperature modification of the heavy rare earth–rhodium alloys of composition Ln_5Rh_3. It is shown that, in the Mn_5Si_3-type phases, the axial ratio increases with increasing values of r_A/r_B or decreasing values of the free electron concentration in the phases. Based on the general trend in the variations, anomalous behavior of either the A- or the B-component atoms is postulated. The $CaZn_5$-type structure is encountered at high temperature ranges in the $LnRh_5$ phases of heavy rare earths. The axial ratio decreases with an increase in r_A/r_B unlike in the Mn_5Si_3-type phases. Yet, the behavior is similar in both cases when variations with respect to free electron concentration are considered. The $CeNi_3$-type structure occurs in the $LnRh_3$ phases of light rare earths (La to Gd, and Y, except Ce) and is favoured when r_A/r_B lies between 1.32 and 1.39. In these phases the axial ratio decreases slightly with increasing values of radius ratio. Based on the variations in the axial ratio, Ce is inferred to be tetravalent in $CeNi_3$. The $PuNi_3$-type prevails at higher values of radius ratio, between 1.39 and 1.50. Cu_3Au-type phases have radius ratios ranging between 1.27 and 1.35. The ranges of radius ratio for $PuAg_3$-, $TiCu_3$-, and YZn_3-type structures are given, and the occurrence of structures at Ln_5X_3, LnX_5, and LnX_3 stoichiometries is reviewed. (auth)

17878 PHASE RELATIONS IN THE MOLYBDENUM–GALLIUM SYSTEM. Bornand, J. D.; Siemens, R. E.; Oden, L. L. (Albany Metallurgy Research Center, OR). J. Less-Common Metals; 30: 205-209(1973).

Diffusion couples and alloys in the molybdenum–gallium system were examined by thermal analysis, x-ray diffraction, electron microprobe, and metallography. Intermetallic compounds were identified and characterized as follows: Mo_3Ga peritectic 1820 ± 20°C, and $MoGa_5$ peritectic 835 ± 5°C. The solubility of Ga in Mo increased from 1.79 at. % Ga at 1275°C to 10.34 at. % Ga at 1700°C. (auth)

17879 STRUCTURAL AND MAGNETIC STUDIES ON RARE-EARTH COMPOUNDS RNiAl AND RCuAl. Oesterreicher, H.

(Oregon Graduate Center, Beaverton). J. Less-Common Metals; 30: 225-236(1973).

RNiAl and RCuAl crystallize with the Fe_2P structure. This structure type is less densely packed than the Laves phases. Most of these materials order ferromagnetically at low temperature but ErNiAl and TmNiAl, which according to the de Gennes function should exhibit relatively weak ferromagnetism, are shown to be subtle metamagnets. The presence of the crystalline electric field is felt rather strongly by the 4f shells of Pr and Nd in this environment so that these materials are exchange enhanced ferromagnets. (auth)

17880 CRYSTAL CHEMISTRY OF THE $CeCu_2$-TYPE STRUCTURE. Debray, D. (CEN de Saclay, Gif-sur-Yvette, France). J. Less-Common Metals; 30: 237-248(1973).

It has been established that the formation of the $CeCu_2$-type structure is primarily based on a high degree of space filling and absence of directed chemical bonding. The packing efficiency is at least as good or greater than cubic or hexagonal close-packing. There are no strict requirements either for the relative sizes of the components or for conduction electron concentrations. (auth)

17881 INFLUENCE OF CARBON AND OXYGEN ON THE BRITTLE BEHAVIOR OF MOLYBDENUM. Touboul, J. P.; Minel, L.; Langeron, J. P. (Centre d'Etudes de Chimie Metallurgique, Vitry-sur-Seine, France). J. Less-Common Metals; 30: 279-300 (1973). (In French).

Carbon can be effectively removed from molybdenum by annealing under a low pressure of oxygen (2×10^{-5} torr). The speed is controlled by the bulk diffusion of carbon. Carbon and oxygen, which are present in solid solution at high temperatures, precipitate on cooling, chiefly at the surface and grain boundaries. This effect is apparently caused by chemisorption of carbon and oxygen at the surface. It seems that carbide precipitates improve the cohesion of grain boundaries. (auth)

17882 LANTHANUM–CADMIUM SYSTEM. Bruzzone, G.; Merlo, F. (Univ., Genoa). J. Less-Common Metals; 30: 303-305(1973).

Preparation of a La–Cd phase diagram is reported. The phase diagram is included along with structural and microhardness data for LaCd intermetallic compounds. (JRD)

17883 ATOMIC ENERGY. Berggren, G. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 341-352 of Differential Thermal Analysis. Volume 2. /Mackenzie, R. C. (ed.). London: Academic Press (1972).

It is pointed out that when differential thermal analysis (DTA) is applied to toxic and radioactive materials, remote-handling equipment is needed. The use of specially designed apparatus by different laboratories has made correlation of results difficult because of the dependence of DTA curves on operation conditions, but more refined and sensitive instruments are now being developed that will allow parameters of importance to be evaluated more precisely. An account is given of the application of DTA to the study of nuclear fuel materials: uranium and plutonium metals and alloys, and uranium and plutonium ceramics. Examples are included of studies of phase diagrams and phase transformations. It is stated that DTA is a convenient tool for the qualitative determination of radiation damage to crystal structures, leading to changes in transition temperatures, melting points, etc.; and in certain cases also for the quantitative determination of such effects of irradiation as the storage of energy through the accumulation of structural defects. Examples of such use are presented, together with suggestions for further application in the field of nuclear materials. (UK)

17884 CONSIDERATIONS OF THE STRESS ANALYSIS AND FRACTURE BEHAVIOR OF WELDED THICK-WALLED PRESSURE VESSELS. Varga, T.; Stumpp, W. Sulzer Tech. Rev.; No. Nuclex 72, 18-28(1972).

The operational safety of ferritic-steel pressure vessels is governed not only by the design criteria for static and dynamic loading but also by the brittle fracture behavior. If a ductile fracture behavior cannot be predicted in advance, then a fracture mechanics evaluation must be made on the basis of the stress state, possible defects in the material, and special material characteristics. Such fracture mechanics evaluation is explained by example. (auth)

17885 EFFECT OF CARBON DISTRIBUTION ON THE STRUCTURE OF MOLYBDENUM AND ITS ALLOYS. Ageev, N. V.; Ignatov, D. V.; Model, M. S.; Kantor, M. M.; Egoshina, S. G. pp 182-189 of Legirovanie i Svoistva Zharopochn. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Electron microscopy, micro-diffraction, and x-ray methods were used to study the structure, with respect to C distribution, of cast Mo as a binary Mo–C alloy. Nonuniformity of C distribution caused by nonuniform crystallization from the liquid state is an important factor in Mo embrittlement. In the presence of C, dilute solid solutions of Ti, Zr, and Hf in Mo, break down with the precipitation of TiC, ZrC, and HfC inclusions within the grains. Quenching from the eutectic temperature is the best method for providing the most uniform C distribution. Post-ageing of these alloys precipitates the above carbides to cause strengthening but retains satisfactory ductility. (Metals Abstr.)

17886 MAGNESIUM–PRASEODYMIUM PHASE DIAGRAM. Bochvar, N. R. pp 21-23 of Struktura i Svoistva Legk. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Thermal and microstructural analyses and electrical-resistance measurements were used to construct the part of the Mg–Pr diagram up to Pr 35%, and to determine the solubility of Pr in Mg. The $\alpha + Mg_3Pr$ eutectic crystallizes at 575 ± 2°C and with Pr 21%. At 575, 540, 500, 400, 300, and 200°C the solubility of Pr in solid Mg is 2.0, 1.3, 0.9, 0.5, 0.35, and 0.2%, respectively. (Metals Abstr.)

17887 INTERACTION OF HAFNIUM WITH CERIUM AND ERBIUM. Kolesnichenko, V. E.; Terekhova, V. F.; Savitskii, E. M. pp 46-50 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Physico-chemical methods were used to study alloys of the Ce–Hf and Er–Hf systems. The former system is distinguished by a wide region of immiscibility in the liquid state and by the degeneration of a eutectic on the Ce side. This lowers the temperature of the allotropic transformation of Hf from 1760 to 1250°C, although Hf has practically no effect on the polymorphism of Ce. The solubility of Hf in Ce at the eutectic temperature (795°C) is <0.5% and of Ce in Hf ~0.5%. The Er–Hf diagram is of the eutectic type with a eutectic reaction at 1447°C and with Hf 27%. The solubility of Hf in Er decreases from ~3% at this temperature to ~1.5% at 600°C. At the eutectic temperature, the Er solubility in Hf is 7% and at 600°C it is 2.5%. Intermetallic compounds do not occur in either system. (Metals Abstr.)

17888 ALLOYS OF CALCIUM WITH RARE-EARTH METALS. Stroganova, V. F.; Terekhova, V. F.; Savitskii, E. M. pp 51-57 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The Ca–Eu and Ca–Yb phase diagrams are reported for the whole concentration ranges. The former shows a continuous series of solid solutions between the high temperature β modifications of Ca and Eu and also the presence of a two-phase $\alpha + \beta$ region on the Ca-rich side. The Ca–Yb system displays limited solubility of the components in the solid states and has a wide region of immiscibility in the liquid solutions. See also Met. A., 7209-11 0660. (Metals Abstr.)

17889 ANALYTICAL CALCULATION OF THE SURFACE ACTIVITY OF NIOBIUM, ZIRCONIUM, AND LANTHANUM. Braun, M. P.; Matyushenko, N. I. pp 73-75 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Some methods proposed by various authors for calculating the surface activity of elements are examined. Results are given for such calculations for Nb, Zr, and La in relation to Fe melts, and an assessment is made of the effect of these elements as microalloying and modifying additions. (Metals Abstr.)

17890 ALLOYS OF RARE-EARTH METALS WITH TRANSITION METALS AND SILICON AND POSSIBLE USES OF SUCH ALLOYS. Bodak, O. I.; Gladyshevskii, E. I. pp 67-72 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

X-ray and microstructural methods were used to study alloys of the ternary Ce–{Fe, Co, Ni}–Si systems and to construct the phase diagrams for the Ce 0–33.3 at. % region. The existence of 24 ternary compounds was established. A series of isostructural compounds was found in the R–M–X systems (R = rare earth, M = transition metal, X = Si or Ge). Most of these compounds have semiconducting properties and could be used to form new semiconducting materials. (Metals Abstr.)

17891 INTERACTION OF METALS OF THE PLATINUM GROUP WITH THOSE OF THE RARE-EARTH GROUP. Savitskii, E. M.; Polyakova, V. P.; Gorina, N. B.; Roshan, N. R. pp 63-67 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The corrosion-resistant Pt-group metals can be alloyed with rare-earth metals to give materials with unique chemical and physical properties. A general study was made of features of the interactions involved in the formation of these alloys. 31 references. (Referativnyi Zh.)

17892 DIFFUSION OF NITROGEN IN NIOBIUM, WITH SPECIAL REFERENCE TO TEMPERATURE DEPENDENCE OF THE ACTIVATION ENERGY. Ogurtani, T. O.; Uygur, E. M. (Middle East Technical Univ., Ankara). Trans. Jap. Inst. Metals; 13: No. 6, 396-399(Nov 1972).

The kinetics of nitrogen diffusion in niobium were studied in the temperature range 900–1300°C by gas–metal absorption experiments. The hardness profile was correlated with the concentration of nitrogen in niobium. It was found that the diffusion kinetics in this temperature range could be represented by a single Arrhenius-type rate equation. The activation energy and the pre-exponential factor were found to be 24.9 kcal/mol and 0.0023 cm^2/sec, respectively. The analysis of available experimental data for diffusion of nitrogen in niobium shows that the apparent activation energy decreases with increasing temperature. An explanation can be formulated in terms of a temperature dependence of the motion enthalpy H_m of interstitial nitrogen atoms. H_m is found to decrease from 38.6 kcal/mol to 24.7 kcal/mol between 280 and 650°C. Above this temperature range the activation enthalpy stays constant up to 1300°C, then it increases suddenly to 50 kcal/mol. (auth)

17893 DIFFUSION OF NICKEL IN NIOBIUM. Agarwala, R. P. (Bhabha Atomic Research Centre, Trombay, India); Hirano, K. I. Trans. Jap. Inst. Metals; 13: No. 6, 424-427(Nov 1972).

Using a residual-activity technique, the diffusion of nickel in niobium was studied in the temperature range of 988 to 1246°C. The temperature dependence of diffusivity can be expressed as $D = 9.3 \exp(-80{,}400/RT)$ cm^2/sec. The diffusion coefficient of nickel was found to be of the same order of magnitude as those of cobalt and iron in niobium. (auth)

17894 EFFECT OF ALLOYING ELEMENTS ON THE STABILITY OF EPSILON IRON. Ishida, Kiyohito; Nishizawa, Taiji (Tohoku Univ., Sendai). J. Jap. Inst. Metals; 36: No. 12, 1238-1245(Dec 1972). (In Japanese).

A dilatometric experiment has been made on the fcc ⇌ hcp martensitic transformation in Fe-Mn-X alloys, and the effects of the alloying elements on the $M_s^{\gamma\to\epsilon}$ and $A_s^{\epsilon\to\gamma}$ temperatures have been studied. It was observed that the $A_s^{\epsilon\to\gamma}$ temperature was lowered by additions of Al, Co, Cr, Cu, Mo, Nb, Ni, Si, Ti, V, W, and C, while the $M_s^{\gamma\to\epsilon}$ temperature was lowered by alloying of the above elements except Co. The parameter $\Delta G_X^{\gamma/\epsilon Fe}$ which represents the effect of alloying element X on the relative stability of γ-iron and ϵ-iron near 500°K has been evaluated by thermodynamic analysis of the $A_s^{\epsilon\to\gamma}$ and $M_s^{\gamma\to\epsilon}$ data. It was found that the value of the parameter $\Delta G_X^{\gamma/\epsilon Fe}$ changes systematically with the group number in the periodic classification. Another parameter $\Delta G_X^{\alpha/\epsilon Fe}$ for α-iron and ϵ-iron was obtained from the values $\Delta G_X^{\alpha/\gamma Fe}$ and $\Delta G_X^{\gamma/\epsilon Fe}$, and the parameter was found to change in accordance with the periodic table. (auth)

17895 THERMAL EXPANSION OF Cu–W FIBER COMPOSITE. Nakazawa, Kozo; Otsuka, Masahiko; Umekawa, Sokichi. (Tokyo Inst. of Tech.). J. Jap. Inst. Metals; 36: No. 12, 1168-1173(Dec 1972). (In Japanese).

The effects of annealing and subzero treatment on thermal dilatation of the W–fiber Cu composite were studied in relation to the residual stress and matrix yielding. For the composite annealed at 600°C for 1 h, the heating curve forms a hysteresis loop with the cooling curve on the test up to 300°C, and a small region of inflection is observed on each curve. By the subzero treatment at −196°C for 10 min the inflection temperature on heating is lowered, but on cooling, it remains unchanged and no hysteresis loop is formed. In the temperature range which reaches the inflection region on heating and cooling tests, the fiber and the matrix undergo elastic deformation. The matrix begins to yield at the inflection. On the heating curve of the subzero cooled composite, the inflection region is observed near room temperature, corresponds to the matrix yielding. The temperature dependencies of expansion and contraction within the temperature range from the start to the inflection on heating and cooling tests below 300°C become smaller with increasing volume fraction of fiber (V_f). The coefficient can be simply estimated by the stress condition. The expansion coefficient beyond the temperature, at which the matrix starts the yielding, is independent of V_f and corresponds to the coefficient of the fiber. The average of the coefficient up to 300°C becomes smaller with the increase of V_f and coincides with the calculated value. (auth)

Radiation Effects

Refer also to abstracts 17925, 18637, 18971, 18972, 18984, 18986–18988, 19103, and 19115–19117.

17896 (COO-2119-3) RADIATION DAMAGE STUDY OF TYPE 304 STAINLESS STEEL BY HIGH VOLTAGE ELECTRON MICROSCOPY. Das, Gopal; Mitchell, T. E. (Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Materials Science). 1972. Contract AT(11-1)-2119. 41p. Dep. NTIS.

AISI Type-304 stainless steel was used as a prototype to study electron irradiation damage as a function of accelerating voltage, irradiation time, and temperature. Discs 0.4 mm thick were cut from as-received 3-mm rods, sand-ground to ~0.2 mm, and most of them encapsulated in a quartz tube under a vacuum of 10^{-5} torr and subsequently annealed at 1100°C for 7 hours. Electron-transparent foils were made from annealed and as-received discs by a two-step process of jet dimpling and electropolishing. These foils were exposed to electron radiation inside a Hitachi HU-650B microscope operating at an accelerating voltage of 650 kV (which is above the threshold energy for atom displacements in stainless steel) at temperatures between room temperature and 640°C. Typical results of radiation damage for different temperatures and exposure time are shown. The black spot defects are presumably interstitial loops found to increase in density and grow in size with increasing exposure time. At 450°C and low fluence, both unfaulted and faulted loops are produced, and they grow in size with high electron fluences. At a still higher temperature, 640°C, the vacancies created by irradiation aggregate into voids. Another feature of interest is the radiation-induced precipitation at higher temperature. These rod-shaped precipitates are oriented in $[1\bar{1}1]$ and $[\bar{1}11]$ direction and are found to grow with time. (TSS)

17897 (HEDL-SA–130) CREEP RUPTURE PROPERTIES OF TYPE 316 STAINLESS STEEL AFTER HIGH TEMPERATURE EBR-II IRRADIATION. Lovell, A. J.; Holmes, J. J. (Hanford Engineering Development Lab., Richland, Wash.). 1971. Contract AT(45-1)-2170. 23p. (CONF-710606–19). Dep. NTIS.

From 17th Annual Meeting of The American Nuclear Society; Boston, Massachusetts, United States of America (USA) (13 Jun 1971).

The effects of fast neutron fluence (10^{22} to 7×10^{22} n/cm^2) on the creep properties of annealed Type 316 stainless steel were studied in the EBR-II, with irradiation temperatures of 1000 to 1400°F. For the highest fluence (7×10^{22} n/cm^2), the rupture life is reduced one-hundred-fold, the creep rate is increased ten-fold, while linear creep is decreased by four-fold. (DLC)

17898 (HEDL-SA–310) EFFECTS OF RADIATION ON STRUCTURAL MATERIALS. Ductility Limitations of Irradiated Type 316 Stainless Steel. Holmes, J. J.; Lovell, A. J.; Fish, R. L. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1972. Contract AT(45-1)-2170. 30p. (CONF-720604–5). Dep. NTIS.

From Symposium on The Effects of Radiation on Structural Materials; Los Angeles, California, United States of America (USA) (26 Jun 1972).

The effect of fast reactor irradiation on the ductility of annealed AISI Type 316 stainless steel is described in terms of strain rate, temperature, and neutron fluence. While considerable irradiation-effects data have been reported previously, the detailed ductility–fluence relationships required to perform steady-state, transient, and safety analyses are not yet available in the literature. To fulfill this need, creep and tension data obtained after EBR-II irradiations are presented and analyzed in terms of controlling deformation mechanisms. The basic nature of each deformation process is used to infer ductility-loss trends and to define the environmental conditions where specific ductility–fluence relationships apply. The resulting correlation quantitatively describes ductility at fluences approaching 1×10^{23} n/cm^2, strain rates from 10^{-8} to 10^4/h, and temperatures from 370 to 760°C. (auth)

17899 (HEDL-SA–323) IRRADIATION STRENGTHENING AND FRACTURE EMBRITTLEMENT OF A533-B PRESSURE VESSEL STEEL PLATE AND SUBMERGED-ARC WELD. Williams, J. A.; Hunter, C. W. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1972. Contract AT(45-1)-2170. 28p. (CONF-720604–6). Dep. NTIS.

From Symposium on The Effects of Radiation on Structural Materials; Los Angeles, California, United States of America (USA) (26 Jun 1972).

Plate and weld material of ASTM A533 Grade B, Class I steel furnished by the Heavy Section Steel Technology Program was characterized for irradiation strengthening and fracture embrittlement. Plane strain fracture toughness, K_{Ic}, in the longitudinal orientation was determined for specimens irradiated at 540°F to neutron fluence levels of 2 and 8×10^{19} n/cm^2 (E > 1 MeV); longitudinal tensile specimens were irradiated at 510°F at 2, 4, 6, and 8×10^{19} n/cm^2 (E > 1 MeV). Yield strength was more sensitive to irradiation strengthening than the ultimate strength and the yield strength increase ($\Delta\sigma_{ys}$, ksi) as a function of fluence (Φ) and temperature (T, °F) may be described by: $\Delta\sigma_{ys} = 22\,[1 - \exp(-\Phi/5 \times 10^{18})] + \Phi/10^{19}\,(4.3 - 0.0038T)$. Irradiation levels of 2 and

8×10^{19} produced shifts of 185°F and 275°F in the 50 ksi $\sqrt{\text{in}}$ K_{Ic} fracture toughness transition of A533 plate; the measured shifts agree closely with those predicted, 153°F and 282°F from a proposed correlation of shift in transition and change in yield strength. K_{Ic} fracture toughness and tensile properties of plate material were independent of the orientation. The fracture toughness of ASTM A533-B submerged-arc weldment metal irradiated at 540°F to a fluence of 3×10^{19} n/cm^2 (E > 1 MeV) exhibited a marked sensitivity for irradiation embrittlement; the indicated shift of the 50 ksi $\sqrt{\text{in}}$ K_{Ic} fracture-toughness transition level was approximately 390°F. The yield and ultimate tensile strengths of ASTM A533-B sub-arc weld were determined for 510°F irradiations to fluences of 0.5×10^{19} n/cm^2 and 4.0 to 4.6×10^{19} n/cm^2 (E > 1 MeV). Irradiation strengthening of weld yield properties is slightly greater than the longitudinal base properties. (auth)

17900 (HEDL-SA-468) TENSILE AND CREEP BEHAVIOR OF COLD WORKED TYPE 316 STAINLESS STEEL AFTER EBR-II IRRADIATION. Fish, R. L.; Lovell, A. J.; Brager, H. R.; Holmes, J. J. (Hanford Engineering Development Lab., Richland, Wash.). Nov 1972. Contract AT(45-1)-2170. 21p. (CONF-721115-3). Dep. NTIS.

The effects of fast reactor irradiation on post-irradiation tensile and creep properties of 20% cold-worked Type 316 stainless steel were investigated. Irradiations were performed in the EBR-II to a peak fluence of 1×10^{22} n/cm^2 (E_n > 0.1 MeV) at temperatures between 450 and 840°C. After irradiation, tensile tests were performed at temperatures from 480 to 870°C and creep tests were performed at 540 and 760°C. Little effect of irradiation on tensile properties was found at test temperatures equal to or less than 540°C. Transmission electron microscopy revealed that some dislocation-loop formation occurred at low irradiation temperatures, but this was insufficient to cause irradiation hardening. At test temperatures in excess of 650°C, helium embrittlement caused a marked decrease in tensile ductility. Irradiation increased creep rates but either decreased or did not affect creep ductility, depending on test and irradiation conditions. In all cases, reduced rupture times were found. (auth)

17901 VOIDS RESULTING FROM FAST-NEUTRON IRRADIATION OF A STABILIZED STAINLESS STEEL. Ehrlich, K.; Packan, N. H. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Mater.; 46: No. 1, 77-85(Feb 1973).

A 16 Cr-13 Ni-niobium stabilized stainless steel (Type 1.4988) was irradiated as fuel pin cladding in the DFR reactor. The irradiation temperatures ranged from 300 to 650°C. Neutron fluences from 3.3 to 4.0 n/cm^2 (E > 0.1 MeV) were achieved. Swelling behavior was studied in this material by transmission electron microscopy, immersion density determinations, and diametral change measurements. Void formation was observed in the temperature range 360 to 610°C. Void concentration values at lower temperatures (<480°C) are comparable to those cited for the unstabilized stainless steels AISI 304 and 316; however, they decrease more strongly with increasing irradiation temperatures. The mean and maximum diameters show a pronounced maximum at about 530°C. The decrease of the void diameters at higher temperatures can be explained by the nature of the cavities observed. Annealing experiments with specimens irradiated at 610°C have revealed a bubble or a mixed void-bubble character for these cavities. Swelling in type 1.4988 was found to be lower than that reported previously for types 304 and 316 at comparable irradiation and material conditions. This is especially pronounced at higher temperature. Diameter changes of the pin at T ≥ 610°C cannot be explained by void formation. (auth)

17902 INHIBITED VOID FORMATION IN DISPERSION-HARDENED AUSTENITIC STAINLESS STEEL DURING HIGH-ENERGY ELECTRON IRRADIATION. Singh, B. N. (Danish Atomic Energy Research Establishment, Risoe). J. Nucl. Mater.; 46: No. 1, 99-102(Feb 1973).

A series of 1-MeV electron-irradiation experiments were carried out in an electron microscope on RMS-1, RMS-2 (5.0 vol % Al_2O_3 particles), and Type 316 stainless steels. Many voids were observed in 316 at 4.65 dpa. At the dose level of 9.3 dpa, the void number density was 7.0×10^{15} in 316, 0.8×10^{15} in RMS-1, and 0.2×10^{15} cm^{-3} in RMS-2. As irradiation progressed, the voids agglomerated in 316, while in RMS-1 their number increased until 28 dpa and then began to decrease, and the number remained almost constant in RMS-2 until the end of the experiment at 36 dpa. The void size at all dose levels is larger in 316 than in the RMS steels. (DLC)

17903 IRRADIATION TEMPERATURE DEPENDENCE OF VOID FORMATION IN COLD-WORKED TYPE 316 STAINLESS STEEL. Brager, H. R.; Straalsund, J. L. (Westinghouse Hanford Co., Richland, WA). J. Nucl. Mater.; 46: No. 1, 103-106(Feb 1973).

The irradiation temperature dependence (380 to 850°C) of void formation was studied for 27% cold-worked Type 316 stainless steel and fast neutron fluxes of 0.8 to 5.1×10^{22} n/cm^2. The two maxima observed show that voids form at low and high irradiation temperatures, but not at intermediate temperatures. This is different from the observations on solution-treated steel; the difference is related to the thermal stability or recovery kinetics of the cold-worked microstructure. (DLC)

17904 IRRADIATION CREEP IN A MATERIALS TESTING REACTOR. Lewthwaite, G. W.; Proctor, K. J. (United Kingdom Atomic Energy Authority, Caithness, Scotland). J. Nucl. Mater.; 46: No. 1, 9-22(Feb 1973).

Helical springs made from titanium, zirconium, nickel, Nimonic 80A, Nimonic PE 16 alloy, and two austenitic stainless steels, namely Firth-Vickers FV 548 and a steel with a composition within the AISI 316 specification, were irradiated in the Dounreay Materials Testing Reactor, at 85°C and 100°C and to neutron fluences up to about 4×10^{24} m^{-2} (>1 MeV), while loaded in tension. Irradiation creep was observed in all the materials studied and initial strain rates/unit stress · neutron ranged from 1 to 1.9×10^{-35} m^4/N for Nimonic PE 16 and zirconium respectively. Data obtained from an earlier experiment are presented again and compared with the present results. Springs which received no heat treatment after coiling unwound during irradiation at rates which were independent of the supported loads. The phenomenon is attributed to the relaxation of internal stresses (produced during the manufacture of the springs) with an irradiation-creep constant which is an increasing function of prior cold work. A mechanism of irradiation creep is proposed which involves the rearrangement of the dislocation network in a crystal as the dislocations climb by absorbing interstitials produced by irradiation. (auth)

17905 STRAIN AGING IN ZIRCONIUM-OXYGEN ALLOYS. Kelly, P. M.; Smith, P. D. (Australia Atomic Energy Commission Research Establishment, Lucas Heights). J. Nucl. Mater.; 46: No. 1, 23-34(Feb 1973).

The parameters affecting the strain aging of zirconium-oxygen alloys were investigated. Strain aging was found to be limited to a temperature range between 200 and 500°C. Transmission electron microscopy showed that strain aging is associated with the formation of a dense dislocation cell structure. Segregation of oxygen atoms to these cell walls is proposed as the mechanism of strain aging in zirconium-oxygen alloys. The low-temperature strength and strain-aging response are attributed to the presence of interstitial oxygen pairs which have an asymmetric strain field and so can interact with both edge and screw dislocations. The effect of neutron irradiation on the strain-aging response is consistent with some form of interstitial trapping by radiation-induced defects. (24 references) (auth)

17906 ELECTRON MICROSCOPY OF ADJUSTED URANIUM. Baker, C.; Lobb, R. C. Jernkontorets Ann.; 155: No. 8, 415-418 (1971).

Adjusted U fed into British Magnox reactors is natural U with 200 to 300 ppM Fe and 500 to 1200 ppM Al. Al forms UAl_2 with α-grain refinement and it affects the swelling behavior of U on neutron irradiation. The precipitate distribution was studied in fuel bars with an electron microscope after thermal cycling, which due to the highly anisotropic lattice expansion of U, leads to stress being built up, and thus a clear substructure emerges (similar to hot working). UAl_2 precipitate coarsening is a function of Al-diffusion in U and increases with increasing lattice vacancy concentration. (Metals Abstr.)

17907 USE OF THE [HIGH VOLTAGE ELECTRON MICROSCOPE] HVEM TO STIMULATE FAST-NEUTRON-INDUCED VOID GROWTH IN METALS. Norris, D.I.R. Jernkontorets Ann.; 155: No. 8, 525-526(1971).

An HVEM can be used for quantitatively determining the dose dependence of void growth in the different phases of irradiation. This can be used for stimulating void growth conditions in structural materials or fast reactor fuel cladding subject to neutron irradiation. (Metals Abstr.)

17908 PENETRATION OF HIGH-VOLTAGE ELECTRONS THROUGH THIN FOILS OF ALPHA-URANIUM. Foreman, A. J. E.; Hudson, B. Jernkontorets Ann.; 155: No. 8, 475-478(1971).

Owing to the high atomic number of U, it exhibits high-voltage effects, i. e., multiple beam diffraction of the high-voltage electrons traversing a U foil, even at lower voltages (50 to 1100 kV). Experimental results of electron channeling effects and voltage-related penetration measurements are given. (Metals Abstr.)

17909 SYSTEM FOR THE IN SITU STUDY OF THE DEFORMATION OF MECHANICAL PARTS IRRADIATED IN A NUCLEAR RE-

ACTOR. Le Bot, C.; de Montpreville, C. T. (to Commissariat a l'Energie Atomique). French Patent 2,106,649. 5 May 1972. Filed date 18 Sep 1970. 11p. (In French).

A system for studying the deformation (principally due to creep) of mechanical parts irradiated in a fast reactor is presented. The device consists of a deformable assembly rigidly attached to two points situated on opposite sides of the part studied. The extension along the line joining the two points is studied. The assembly is provided with means for subjecting the part studied to the required temperature, hydrostatic pressure, and stresses. A rod joined to one of the connecting points of the part supports the probe of the electrical transducer device. Another device is used to measure the displacement of the probe. This device encloses the part and the probe holder rod and is provided with a micrometer screw actuated by a remote-controlled motor. The deformable assembly consists of two concentric vessels separated by a layer of gas. The system is immersed in the water of the reactor. Its principal application is in measurement of creep of U test bars. (auth)

17910 REPLY TO "COMMENTS ON 'ON THE QUESTION OF VOID FORMATION IN NEUTRON IRRADIATED ZIRCONIUM'." Wolfenden, A.; Farrell, K. (Oak Ridge National Lab., TN). Scr. Met.; 7: No. 1, 41(Jan 1973).

It has not been established that gaseous impurities must be precipitated in order to act as nuclei for the aggregation of radioinduced point defects. On the contrary, some experiments on V and Mo indicate that gases in solution promote void formation. The role of gases is likely to be more complex than Ferguson indicates. (LLC)

17911 POSSIBLE MECHANISM OF IRRADIATION CREEP. Lewthwaite, G. W. (Dounreay Experimental Reactor Establishment, Thurso, Scotland). Scr. Met.; 7: No. 1, 75-79(Jan 1973).

A mechanism of creep proceeding from the formation of interstitial dislocation loops is described. It is applied first to fcc metals. Equations are derived for the creep strain from the unfaulting. An experimental test of the mechanisms, using changes in stress during irradiation, is suggested. The possible significance of the unfaulting mechanism to fcc metals (stainless steels) is considered. (DLC)

17912 COMMENTS ON "ON THE QUESTION OF VOID FORMATION IN NEUTRON-IRRADIATED ZIRCONIUM." Ferguson, I. F. (Reactor Fuel Element Lab., Springfields, Eng.). Scr. Met.; 7: No. 1, 39(Jan 1973).

Wolfenden and Farrell (Scr. Met., 6: 131 (1972)) found no evidence of voids in neutron-irradiated Zr. It is pointed out that Zr can dissolve considerable amounts of such impurities as O, N, and H, which will not precipitate and thus cannot form nuclei on which vacancy clustering can occur. (DLC)

17913 PRIMARY NEUTRON DAMAGE STATE IN FERRITIC STEELS AND CORRELATION OF CHARPY V-NOTCH TRANSITION TEMPERATURE INCREASE WITH FRENKEL DEFECT DENSITY WITH NEUTRON IRRADIATION. Nomakuchi, Michiyoshi (Ship Research Inst., Tokyo). Pap. Ship Res. Inst. (Jap.); No. 38, 1-29(Mar 1972).

The number of Frenkel defects with neutron irradiation and their spatial distribution per primary knock-on in ferritic steels, in the primary damage state, are calculated by tracing the interatomic collision cascade initiated by an energetic primary knock-on atom. From the results of those calculations, the dependence of the channeling occurrence on the incident neutron energy is found. From those calculated data, the neutron damage function covering the entire neutron energy range is obtained. The Frenkel-defect density with neutron irradiation (Frenkel defects/cm^3) is introduced as a measure of the number of Frenkel defects with neutron irradiation and their spatial distribution in metals is introduced. Use of this method leads to better correlation with the neutron-induced increase in the Charpy V-notch transition temperature of ferritic steels than the neutron fluence (neutrons/cm^2 > 1 MeV, fission spectrum). The experimental data by C. Z. Serpan, Jr. and L. E. Steels are used for the comparison of those correlations. A procedure is also presented for the estimation of a lifetime embrittlement level of ferritic pressure-vessel steels for a power reactor design. (auth)

17914 DISLOCATION LOOP NUCLEATION IN IRRADIATED METALS. Russell, K. C.; Powell, R. W. (Massachusetts Inst. of Tech., Cambridge). Acta Met.; 21: No. 3, 187-193(Mar 1973).

The formalism for analyzing the co-precipitation kinetics of vacancies and self interstitials into voids is extended to the nucleation of positive and negative prismatic dislocation loops in a reactor environment. Steady-state nucleation rates and incubation times are calculated for various conditions of temperature and supersaturation. Vacancy loop formation is particularly sensitive to interstitial involvement; the nucleation rate may drop by twenty orders of magnitude for a miniscule change in interstitial arrival rate. Both kinds of loops may nucleate under conditions typical of the fast breeder reactor, but interstitial loops are predicted to form much more readily. Incubation times are typically $\lesssim 1$ sec so that steady-state nucleation is obtained rather quickly after any change in temperature or in defect concentrations. (auth)

Other Materials

Refer also to abstracts 17424, 17494, 17785, 17868, and 18976.

17915 (RHEL/R-249) IRRADIATION DAMAGE STUDIES OF SOME EPOXY RESIN SYSTEMS OF REDUCED VISCOSITY. Evans, D.; Morgan, J.T.; Stapleton, G.B. (Rutherford High Energy Lab., Chilton (England)). Apr 1972. 19p. Dep. NTIS (U.S. Sales Only). UK 25 pence.

Postirradiation mechanical properties are given for a number of epoxy materials, including some glycidyl amine resin systems having reduced viscosities. (auth)

17916 (UCRL-51300) GROWTH OF BUBBLES IN LITHIUM HYDRIDE DURING IRRADIATION. Leider, H. R. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Nov 1972. Contract W-7405-Eng-48. 9p. Dep. NTIS.

The growth of hydrogen gas bubbles in LiH during irradiation is described by a supersaturated-solution model. The activation energy for migration of the molecules in LiH is found to be 0.6 to 0.7 eV. Migration is presumably by an interstitial path. (auth)

17917 STUDIES ON OBTAINING NICKEL BORIDES FROM SOLUTIONS. Bliznakov, G. M.; Peshev, P. D.; Gyurov, G. Ts. (Inst. of General and Inorganic Chemistry, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 9, 1209-1212(1972).

Results of investigations on preparation and structure of amorphous nickel boride are presented. It was found that the composition is Ni_2B by chemical analysis, but closer to Ni_3B on x-ray patterns. It is noted that the appearance of spectral lines characteristic of Ni_3B is expected in this member of the Fe_3C-type group identified by its stability and broad range of homogeneity. (JRD)

17918 STUDY OF THE INFLUENCE OF GAMMA RADIATION ON SOME WATER-RESISTANT PAINT COATINGS. Shigorin, V. G.; Egorov, B. N. Lakokrasoch. Mater. Ikh Primen.; No. 3, 24-26(1971). (In Russian).

Results are given of investigations into the influence of γ radiation on the physico-mechanical properties of epoxy-pitch and chlorsulfonated polyethylene coatings. Parameters measured included adhesion, strength, hardness, and solubility in toluene. IR spectroscopy was used to evaluate changes occurring at the molecular level. Epoxy-pitch coatings were found to be highly resistant to radiation and enamel SP-EK-4 is recommended for protection of building structures and equipment at atomic power stations. (Corros. Abstr.)

17919 MIXED SORPTION MODELS AND ISOTHERMS OF THE CESIUM–RUBIDIUM–GRAPHITE SYSTEM AT HIGH TEMPERATURES. Haire, M. J.; Zumwalt, L. R. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng.; 50: No. 2, 91-97(Feb 1973).

To determine fission product–graphite sorption behavior, an experimental and analytical study was conducted to obtain a model which would predict the vapor pressures of mixtures of sorbed fission-product metals as a function of temperature and composition. The graphite sorbents studied were SP-1C, a very pure natural flake graphite, and TS-688, a typical needle-coke nuclear-grade graphite. Cesium and rubidium tagged with ^{137}Cs and ^{86}Rb were the sorbates, and the pseudo-isopiestic method was used to determine sorbate concentrations as a function of temperature and vapor pressure. Three models were examined for their capability in predicting binary mixed-sorption behavior. Results showed that the vapor pressure of a species varies inversely with the fraction of total sorbate metal present at a given sorbate concentration and temperature and that thermodynamic and FREVAP models were the most successful in the prediction of binary sorption behavior from single component isotherm data. It is concluded that if the departure from ideal adsorption behavior is not known, either model may be used in the calculation of fission-product release. (auth)

17920 POLYIMIDE COMPOSITES DEVELOPMENT FOR AIRCRAFT STRUCTURES. Kollmansberger, R.; Birchfield, E. SAMPE Quart.; 4: No. 2, 28-39(Jan 1973).

A program is described in which boron/PI and graphite/PI

structural parts were successfully fabricated on a production basis. The fabrication cycles for the polyimide composites were shortened to approach epoxy times. Low void contents were produced as evidence by the good matrix dependent properties. Potential problem areas are discussed, including prepreg manufacturing variables and the need for consistent quality control testing by the user. (auth)

17921 DIFFERENTIAL THERMAL ANALYSIS. VOLUME 2. APPLICATIONS. Mackenzie, R. C. (ed.). London: Academic Press (1972). vp. Pounds 12.50.

The subject matter of Volume 2 is covered in 21 chapters grouped into two sections: physical chemistry (determination of physical constants, calorimetric measurements, reaction kinetics, phase studies, low-temperature studies); applications in industry (ceramics, building materials, cements, glass, mineral industries, soils, catalysts, atomic energy, explosives, plastics and rubbers, textiles, pharmaceuticals, oils, fats, soaps and waxes, food industries, forest products, general applications in industry with special reference to dusts). The chapter on atomic energy applications was in NSA scope, and a separate abstract was prepared for it. (UK)

For an abstract of an individual paper see: 17883.

17922 BEHAVIOR IN TIME AND IN A RADIATION FIELD OF SOME SHIELDING CONCRETE TYPES FOR GAMMA AND NEUTRON RADIATION MANUFACTURED WITH ROMANIAN-MADE AGGREGATES AND BINDING MATERIALS. Balanescu, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 7, 791-810(1972). (In Russian).

Experimental studies were devoted to the question of the behavior of some concrete types manufactured using Romanian-made aggregates and binding materials, when subjected to temperature rise and neutron irradiation during the life span of a reactor. Such criteria as time stability in a radiation field and suitable behavior against high temperatures of special absorption concrete for gamma and neutron radiation for protective shielding lead to the selection of the following concrete types: concrete with baryta hydrate for gamma shielding and concrete with corundum, serpentine, and rare earths additions for neutron and gamma shielding. These concrete types were manufactured with Romanian-made aggregates and binding materials. It was thought that the results obtained will allow their use for the industrial objectives of the Romanian power program. The irradiations were carried out at the Melusine reactor (CEN–Grenoble) by using cylindrical probes (5 cm diameter for the concrete with baryta hydrate) and parallelepipedal (3 cm × 3 cm × 3 cm and 4 × 4 × 16 cm) for the ones with rare earth additions. (auth)

17923 RADIATION-RESISTANT INSULATING MATERIAL. Brechna, H. (to United States Atomic Energy Commission). German Patent 1,719,241. 6 Apr 1972. 25p. (In German).

An electrical insulating material is described for electric, thermal, and mechanical protection of highly loaded conductors, which appears resistant to all radiation. This material is needed for the insulation of focusing and deflecting magnet coils in cathode ray tubes for accelerators. The insulating material consists of an inorganic non-conducting supporting fabric, especially glass fiber fabric impregnated with a mixture of duroplastic synthetics as binding agent and an inorganic filled shielding material against nuclear radiation. The material has an electrical and mechanical resistance to a radiation dose several hundred times greater than known insulating coating materials. This is because of the invention's relatively high proportion of impregnation of inorganic filler material as well as the absence of gas enclosures and volatile materials due to the preparation procedure. (GF)

17924 STRENGTH OF BORON FILAMENT. Morita, Mikio; Takeda, Hiromitu; Arima, Ituo (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). J. Jap. Inst. Metals; 36: No. 12, 1213-1217(Dec 1972). (In Japanese).

Boron filaments are tested in tension and the influence of gauge length on their mechanical properties is discussed. The mean fracture stress increases as the specimen's gauge length becomes shorter due to the decrease in flaw existence probability. The bundle strength, which may be used in the "Rule of Mixture" for a composite strength design, is also discussed in relation to the effect of the gauge length of filaments and also to a large variation in filament's strength even if tested at a fixed length. Effects of heat treatment in various atmospheres on the fiber's strength are also studied, and the necessity of protective coating is pointed out. (auth)

17925 STUDIES ON ENGINEERING AND ECONOMIC ASPECTS OF A NEW IRON MORTAR MATERIAL FOR REACTOR SHIELDING. Hungerford, H. E. (Purdue Univ., Lafayette, IN). Nucl. Eng. Des.; 23: No. 3, 347-358(1972).

Results of experimental physical and nuclear tests, shield calculations, and a cost analysis on a recently developed iron mortar shielding material are presented. Measurements taken after heating at 300°F for 7 days indicated no significant change in either physical properties or neutron-attenuating characteristics. After a second heating at 600°F test results indicated about a 3% weight loss (due to loss of water content), a slight color change, and a 4% increase in the neutron transmission through 12 inches of the material. Rupture tests performed on one control block and one heated block indicated a marked loss of strength as a result of heating. The shield calculations performed, both using the ANISN computer code and by hand, were comparative studies using the iron mortar material in the sacrificial shield of a boiling water reactor, in place of ordinary concrete, the material presently designed into these shields. Results of investigation indicated that an iron mortar and steel shield 18.5 inches thick is equivalent to an ordinary concrete and steel shield 27.75 inches thick, a savings of about $\frac{1}{3}$ the concrete shield thickness. A cost comparative analysis-performed on the shield indicated that the iron-mortar shield is not only less costly, but also that the potential savings in capital costs because of the smaller overall size of the shield is many millions of dollars. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 19339 and 19340.

17926 (AED-CONF-72-12-7) NONDESTRUCTIVE ASSAY TECHNIQUES AND APPLICATIONS FOR SAFEGUARDS AND MATERIAL ACCOUNTABILITY. Johnson, W. S. (Eberline Instrument Corp., Santa Fe, N. Mex.). 1972. 9p.

A survey is given on the mode of operation of the safeguards instruments developed at LASL which are commercially available: passive gamma assay–determination of ^{235}U and ^{239}Pu by measurement of the gamma energies of 185.6 keV and 413.7 keV, respectively, using NaI and Ge(Li) detectors; passive neutron assay–coincidence counting of neutrons produced by spontaneous fission in Pu isotopes and/or natural uranium, and active neutron assay–irradiation of the sample with neutrons (^{252}Cf neutron source) and measurement of resulting fission neutrons and gamma rays. (INIS)

17927 (BNWL-SA-4062) CONCEPTUAL ROLE OF REDUNDANCY IN VERIFICATION. Bennett, C. A.; Granquist, D. P.; Schneider, R. A.; Stewart, K. B. (Battelle Pacific Northwest Labs., Richland, Wash.). 1 Dec 1971. 60p. (CONF-711037-5). Dep. NTIS.

From Panel on Quantitative Data and Results of Systems Analysis and Integral Tests; Vienna, Austria (4 Oct 1971).

The effectiveness of various elements of a safeguards system in maintaining adequate control over the location and disposition of nuclear materials is discussed. The main safeguards method chosen for application by the IAEA in carrying out its safeguards tasks under the Non-Proliferation Treaty (NPT) is that of verified materials accounting. The other elements of safeguards, i.e., containment and surveillance, play supporting roles. They validate the measurement verification activities carried out at strategic points. A detailed examination was made of several key aspects of verified materials accounting. These are: the value of redundancy in a fuel cycle completely internal to a nation; the value of technical cross-checks in providing a more robust system and in limiting the extent to which alternate inspection strategies could be defeated; and the contribution of these activities in quantifying the effectiveness of verification activities. The results of these considerations provide a framework for allocating verification effort throughout an internal fuel cycle. The results also provide useful guidelines for relating effort to effectiveness. The concepts and principles involved are discussed in the context of an example fuel cycle. The fuel cycle which is internal to a nation includes low enriched U fabrication, light-water reactors, chemical processing, U & Pu storage, Pu fabrication, and U product conversion. The results of the study are discussed. (RCK)

17928 (LA-5091) NUCLEAR ANALYSIS RESEARCH AND DEVELOPMENT. Program Status Report, May–August 1972. (Los Alamos Scientific Lab., N. Mex.). Nov 1972. Contract W-7405-eng-36. 28p. Dep. NTIS.

Research progress is reported on neutron interrogation and nondestructive assay of nuclear fuels and fabricated fuel components, materials analysis using isotopic sources, gamma-ray analysis, and detector and instrumentation development. Re-evaluation of LASL delayed-neutron yield data is included. (TFD)

17929 NUCLEAR FUEL ASSAY SYSTEM. Untermyer, S. (to National Nuclear Corp.). U. S. Patent 3,707,631. 26 Dec 1972. Filed 2 Apr 1970.

A system for the nondestructive assay of nuclear fuel is disclosed. A scintillating body is positioned near the fissionable fuel species to be assayed. An interrogating beam of low energy neutrons is passed through a moderating material to reduce the neutrons to the thermal or low epithermal regions. The moderated interrogating beam penetrates a selected segment of the fuel. Fission of the fissionable species radiates fast neutrons into the scintillating body producing proton recoil in hydrogenous material. These protons produce scintillation events in large sized phosphor grains. Photons from the scintillation events are carried through a transparent light guide to a light detector for counting. The light guide is disclosed as a substantially transparent, non-scintillating polymer surrounded by a light reflecting layer which in turn is covered by a light shield. In a modified form the nuclear fuel to be assayed is positioned in a cavity enclosed by a moderating material with a neutron source and scintillating body radially positioned from the cavity. The scintillating material is arrayed in a series of grooves formed in a transparent light guide connected with a counting device. (Official Gazette)

Disposal and Storage

Refer also to abstracts 17241, 17245–17247, and 17602.

17930 (BNWL-B-192) SIZE REDUCTION OF LARGE CONTAMINATED PROCESS EQUIPMENT USING EXPLOSIVE SHAPED CHARGES. Final Report. Kaser, J. D.; Vining, J. O. (Battelle Pacific Northwest Labs., Richland, Wash.). Nov 1972. Contract AT(45-1)-1830. 21p. Dep. NTIS.

A possible method of dismantling large contaminated process equipment using linear shaped charges is described. Test procedures, explosive charges, test equipment and photographs of setups are included. A 16 mm film illustrating the test demonstrations was prepared. (auth)

17931 (SZS-138) (STORAGE OF RADIOACTIVE WASTES.) (Staatliche Zentrale Fuer Strahlenschutz, Berlin (East Germany)). Sep 1972. 45p. (In German). Dep. NTIS (U.S. Sales Only).

Four papers on the storage of radioactive wastes are presented. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 17932 through 17935.

17932 (SZS-138, pp 1-10) STUDY OF VARIANTS FOR SELECTING A METHOD OF ULTIMATE STORAGE OF RADIOACTIVE WASTES FROM NUCLEAR FACILITIES IN THE GDR. Fischer, W. (Institut fuer Kraftwerke, Berlin); Koerner, W.; Richter, D. Sep 1972. (In German).

Starting from technological parameters influencing the disposal of radioactive wastes, as to the amounts and properties of wastes from nuclear power stations and plants of the nuclear fuel cycle, possible methods of treatment and final disposal of radioactive wastes are outlined. These methods are discussed from the points of view of safety and economy. The procedure chosen is explained and assessed considering the conditions in the GDR. (auth)

17933 (SZS-138, pp 11-17) COMPUTING PROGRAMME FOR SELECTION OF VARIANTS OF RADIOACTIVE WASTE DISPOSAL FROM NUCLEAR PLANTS. Fischer, W.; Buhl, G. (Institut fuer Kraftwerke, Berlin). Sep 1972. (In German).

A program is described for the economic evaluation of technically useful combinations of procedures and technologies for the treatment and ultimate disposal of radioactive wastes from nuclear plants. In addition to safety criteria the results may be used in selecting variants. The functional relationships are given and the performance and limits of the program are discussed. (auth)

17934 (SZS-138, pp 19-30) ULTIMATE STORAGE OF HIGH LEVEL RADIOACTIVE WASTES IN SALT FORMATIONS: STAGE OF DEVELOPMENT AND PROBLEMS. Mosler, H. (Deutsches Brennstoffinstitut, Freiberg i. B.). Sep 1972. (In German).

The preparatory investigations (geological, geophysical, and geomechanical) necessary for the large-scale storage of high-level radioactive wastes are reviewed. The concept of ultimate storage is based on a one-level storage field at a depth of several 100 m in a diapiric salt deposit. The boreholes in the storage chambers should be deep enough so that each of them can take many storage items. It was concluded that ultimate storage of processed high-level radioactive wastes may be most advantageous in deep rock salt formations. (auth)

17935 (SZS-138, pp 31-45) ACCIDENTAL SITUATIONS IN STORING RADIOACTIVE WASTES IN A ROCK-SALT MINE. Franke, H. (Deutsches Brennstoffinstitut, Freiberg i. B.). Sep 1972. (In German).

A method is presented which permits evaluation of accident situations in storing radioactive wastes in a rock-salt mine. In this connection factors are discussed which may lead to flooding of the mine. Furthermore, a concept is evolved on the possibilities of contamination of solutions infiltrating into the mine as well as of the infiltration of contaminated solutions into water-bearing strata. This requires consideration of the possible destruction of the underground workings caused by dissolution of the salt. It is concluded that structural safety of the mine may be an essential factor with regard to the safety of the environment around a disposal facility. Though hazards to the environment are of low probability considerations with regard to accidental situations should not be omitted. (auth)

17936 (SZS-139) (STORAGE OF RADIOACTIVE WASTES). (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Sep 1972. 30p. (In German). Dep. NTIS (U.S. Sales Only).

A separate abstract was prepared for each of the two articles in this report. (TFD).

For abstracts of individual papers see: 17937 and 17938.

17937 (SZS-139, pp 1-17) STORAGE IN GASEOUS RADIOACTIVE WASTES IN GEOLOGICAL FORMATIONS. Schulze, H. (Deutsches Brennstoffinstitut, Freiberg i. B.). Sep 1972. (In German).

Possibilities for the ultimate storage of gaseous radioactive wastes in the ground are presented taking into consideration safety, from a geological point of view, and the costs of the different types of storage. The geological tightness necessary for the safe underground storage of gaseous radioactive wastes as well as the assessment of the criteria of tightness are discussed. Besides the possible procedures for the ultimate storage, a method is proposed for interim storage of radioactive gases in the ground. (auth)

17938 (SZS-139, pp 18-30) SIMPLE MODELS OF MIGRATION OF FISSION GASES (^{85}Kr) THROUGH THE OVERLYING ROCKS OF UNDERGROUND STORAGE FACILITIES. Boettcher, A. (Deutsches Brennstoffinstitut, Freiberg i. B.). Sep 1972. (In German).

Two simple models of diffusion of ^{85}Kr through the overlying rocks of underground storage facilities are presented. The derived solutions render it possible to assess the necessary undistributed thickness of the overlying rocks of an underground reservoir which is used for the storage of ^{85}Kr. (auth)

17939 (SZS-140) (LIQUID AND SOLIDIFIED RADIOACTIVE WASTES). (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Sep 1972. 36p. (In German). Dep. NTIS (U.S. Sales Only).

A separate abstract was prepared for each of the three articles contained in this report. (TFD)

For abstracts of individual papers see: 17940 through 17942.

17940 (SZS-140, pp 2-14) FEASIBILITY OF DISPOSAL OF LIQUID RADIOACTIVE WASTES INTO THE DEEPER GEOLOGIC SUB SURFACE ON THE TERRITORY OF THE GDR. Adam, C.; Koerner, W.; Richter, D. Sep.1972. (In German).

The disposal of liquid low- and intermediate-level radioactive wastes into deep geologic formations in the GDR is considered and contrasted to the experience gained from analogous procedures for the disposal of conventional liquid wastes. The disposal of liquid radioactive wastes into cavities of salt rock or into abandoned petroleum or natural gas reservoirs is assessed as a suitable procedure and evaluated considering technical, economic, and safety aspects. Certain conditions in several limited regions of the GDR would permit the use of these methods. However, in most cases these regions are not near planned sites for nuclear plants. With regard to the central disposal of solid and liquid radioactive wastes of all activity levels, the use of an abandoned rock salt mine is preferred to the above-mentioned procedures. (auth)

17941 (SZS-140, pp 15-23) FEASIBLE PREVENTIVE AND COUNTER-MEASURES FOR ACCIDENTAL SITUATIONS IN STORING LIQUID RADIOACTIVE WASTES IN TANKS. Sachse, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Johannsen, K. Sep 1972. (In German).

Starting from the presentation of procedures used in water engineering and conventional industries to protect ground waters from being contaminated with toxic substances, the measures which have been proven useful and their feasibility for diminishing the hazard of contamination of soil and ground water with radioactive substances are discussed. Possibilities of introducing chemical barriers into the ground are especially considered. Their applicability under the conditions existing in the GDR is discussed. (auth)

17942 (SZS-140, pp 24-36) LEACHING BEHAVIOR OF SOLIDIFIED LOW- AND INTERMEDIATE-ACTIVITY WASTE CONCENTRATES. Koerner, W. Sep 1972. (In German).

Concentrates from an evaporator were solidified by incorporating them into cement, anhydrite, or bitumen. The samples obtained were treated with water or NaCl solutions, their leaching behavior was characterized by the diffusion coefficient D. Useful results were obtained for cement and anhydrite samples. With cement, D is strongly dependent on the nuclide (Na, ^{134}Cs: $D = 10^{-2} \ldots 1$ cm^2/d; ^{60}Co, ^{89}Sr: $D \approx 10^{-8}$ cm^2/d). The $NaNO_3$ and NaCl contents of the sample as well as the NaCl concentration of the leaching solutions were of little influence. The properties of anhydrite samples were less favorable ($D = 0.1 \ldots 1.5$ and $\approx 10^{-4}$ cm^2/d). The leaching behavior of bitumen samples showed only a poor dependence on the embedded nuclide ($D \approx 10^{-6}$ cm^2/d). From the diffusion coefficients the thickness of leached volume elements was calculated. (auth)

17943 NOTE ON DISPOSAL OF RADIOACTIVE WASTES IMMOBILIZED IN CERAMIC SLUGS. Shenderova, V. G.; Pavlov-Verevkin, B. S.; Pavlova-Verevkina, A. I.; Glotov, I. I. This paper was summarized in At. Energ. (USSR); 31: No. 5, 511(Nov 1971) as paper No. 541/6085. (In Russian).

Full copy of this paper is held by TIC.

Experiments were performed on the fabrication of ceramic slugs from hydroxide pulps produced in the course of sedimentation processes of deactivation of radioactive wastes; and covering loams, for the purpose of determining their suitability in definitive disposal of radioactive wastes. Fabrication of ceramics at optimum pulp and loam ratios brought about a contraction of 15% in the pulp volume and contraction of the volume of processed water to from 0.3 to 0.4% the original volume. The stability of the resulting ceramic slugs increases with increasing calcining temperature from 900° to 1100°C, and increases at a particularly steep rate in the range between 1050° to 1100°C. The ceramic slug material contained a mixture of isotopes, with specific α-activity equal to the specific β-activity, e.g., 1.3×10^{-10} Ci/g. It was found, as a result of a study of leaching of radioactive isotopes, that ceramics fabricated at from 1050 to 1100°C leached out to a depth of 1.5 to 2.5 mm over the entire duration of the experiments. Comparison of the behavior of α- and β-emitters revealed that the latter, among which are counted many highly mobile elements, leach out much more readily than the former. This is due to the chemical properties of the elements represented by the specific isotopes. The ceramic material obtained from the hydroxide pulp and covering loams at from 1050 to 1100°C is suitable for final immobilization and disposal of radioactive wastes, and does not require leak-tight burial grounds for safe storage. (auth)

17944 RADIOACTIVE DECAY SYSTEM WITH A HYDRO-EJECTOR FOR THE DILUTION OF RADIOACTIVE WASTES. (to Etablissements Lemer et Compagnie). French Patent 1,604,662. 3 Jan 1972. Filed 19 Nov 1968. (In French).

Certain radioactive products administered to patients are eliminated in the urine which subsequently possesses a nonnegligible level of activity and cannot be evacuated into the sewers. The special water closet (WC) described separates the solid and liquid waste matter in a special bowl divided into two compartments. A tube carries a controllable quantity of liquid waste into a tank having several compartments or into separate tanks in which the radioactive wastes are stirred and chronologically separated. After a given period of time, the level of activity drops and the waste liquid is evacuated into the sewers by a liquid jet lift which produces a considerable simultaneous dilution. The evacuation is thus performed with a diluted product and presents a residual volumetric activity consistent with the regulations in force. (FR)

17945 METHOD FOR THE DISPOSAL TO GROUND OF SOLID RADIOACTIVE WASTES. Stogner, J. M. (to Halliburton Oil Well Cementing Co.). German Patent 2,039,130. 10 Feb 1972. 21p. (In German).

The injection and storage of solid waste granulate mixed with cement into an underground soil formation. Dry cement is mixed with aqueous liquid and the solid and ground radioactive waste is added by stirring the mixture. While a continuous water phase is maintained, the mixture is pumped into a borehole and thus brought close to a geologic formation, where it is forced under pressure in order to split the formation. The mixture is pressed into the cracks and is allowed to set. The radioactive, hardened packings are protected by another charge of nonradioactive cement sludge being placed radially around the borehole in order to seal the radioactive material. (GF)

17946 REGULATORY ASPECTS OF ENVIRONMENTAL PROTECTION WITH REGARD TO RADIOACTIVE WASTES AND EFFLUENTS PRODUCED BY NUCLEAR INSTALLATIONS IN THE GDR. Richter, D. (Staatliche Zentrale fuer Strahlenschutz, Berlin). pp 1001-6 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The current regulations of the GDR concerning the disposal of radioactive waste products and the release of radioactivity with gaseous and liquid effluents from nuclear installations are discussed. The National Center for Radiation Protection has the responsibility of defining the safety methods used to dispose of radioactive wastes and to determine the limits acceptable for discharge or storage in view of the risk to the environment and the population. These limits depend upon the quantity, type of activity, category, and distribution of the wastes and effluents. The GDR considers that abandoned salt mines are the most suitable means of disposing of the low, intermediate, and high

activity radioactive wastes likely to be produced in the next decade by the increased number of nuclear power plants. Although the environment has a certain capacity for storing radioactive materials its use for storing radioactive discharges from nuclear installations must be minimized. (France)

17947 RADIOACTIVE WASTES. Vesely, V. Prague; Academia (1971). 154p. (In Czech.).

The problems of deactivation and disposal of radioactive wastes from nuclear installations are discussed, and a brief outline of possible solutions is given. Sources, amounts, and composition of radioactive wastes are discussed along with the water conservancy and hygienic problems presented by radioactive waste waters; deactivation stations, specialized research institutes, and nuclear power plants; the disposal of wastes from spent fuel reprocessing; the treatment and the disposal of solid wastes; and the separation of gaseous exhalations. (Nucl. Sci. Abstr. Czech.)

Handling Equipment and Procedures

Refer also to abstracts 17464 and 17604.

17948 (ARH-SA-138) ATLANTIC RICHFIELD HANFORD COMPANY COMPACTION FACILITIES. Anderson, K. J. (Atlantic Richfield Hanford Co., Richland, Wash.) Oct 1972. Contract AT(45-1)-2130. 14p. (CONF-721030-4). Dep. NTIS.

Facilities being installed for the compaction of both contaminated and noncontaminated combustible wastes are described. The facilities for noncontaminated combustible wastes comprise collection containers, two front-loading compactor trucks, and a centrally-located continuous landfill. Facilities are provided for the entire Hanford site. For compliance with Executive Order 11507, open-pit burning as currently practiced will be discontinued when the compaction facilities are available in early calendar year 1973. The facility for contaminated service on transuranic wastes comprises a 10-ton hydraulic press for compaction directly into 55-gallon drums for 20-year retrievable burial in compliance with Immediate Action Directive 0511-21. Features for personnel safety and contamination control in the facility are described. (auth)

17949 (ARH-SA-139) ATLANTIC RICHFIELD HANFORD COMPANY TRANSURANIC WASTE RETRIEVABLE BURIAL. Heald, W. R. (Atlantic Richfield Hanford Co., Richland, Wash.) Oct 1972. Contract AT(45-1)-2130. 10p. (CONF-721030-5). Dep. NTIS.

The Atlantic Richfield Hanford Company (ARHCO) has recently designed, built, and initiated operation of a prototype V-trench for the retrievable burial of 55-gallon drums in compliance with Immediate Action Directive (IAD) 0511-21. The basic intent of the trench is to provide a concrete base for the pile of drums to keep them from contact with earth for reduced drum corrosion. The V-design holds the drum stack together and provides a strong geometric pile to support the earth load. Accessory features include a portable dust cover for use during the filling operation, an exhaust blower with high-efficiency particulate air filtration for monitoring drums for failure (for the prototype only), and a drain gutter with sump for water collection from precipitation during the filling operation. The prototype V-trench was not intended to be the ultimate for transuranic waste drum storage but does represent an improvement over direct burial. Whether or not it is the most economical method is a significant unanswered question. The cost of direct burial is relatively low, but retrieval and repackaging of damaged or failed drums could be exorbitant. The first cost of the V-trench is high, but retrievable costs should be very low. Design improvements to the prototype trench will be incorporated in future trenches to decrease the construction cost drastically and improve the utilization of land. (auth)

17950 (JAPFNR-71) OUTLINES OF MATERIAL MONITORING FACILITY. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Mar 1972. 56p. (PNC-N-72-8). Dep. NTIS (U. S. Sales Only).

The Materials Monitoring Facility (MMF) under construction near the JOYO reactor consists of a two-story building containing offices, laboratories, decontaminating room, hot cells, materials handling equipment, and materials testing facilities. The facility will be used to conduct materials testing to ensure the safety of JOYO components, to test spent fuel cladding, and to perform post-irradiation testing of structural materials used in reactors. Information is included on plans for irradiating test specimens, dimensions of materials testing specimens, building lay-out, sequence of operations, structure and function of cells, and equipment specifications. (LCL)

17951 (LIB-Trans-490) PRINCIPLES OF CRITICALITY SAFETY IN PROCESSING AND HANDLING FISSILE MATERIALS. Translated by A. Bicevskis (Australian Atomic Energy Commission Research Establishment, Lucas Heights) from German Standard DIN 25 403. Jan 1970. 12p. Dep. NTIS (U. S. Sales Only).

Recommendations summarizing the significant safety aspects concerning fissile materials in such quantities that criticality is possible, are made in the areas of planning installations for fabrication, processing and refabrication of fuels (irradiated or otherwise); operation of the corresponding processes; and storage of nuclear fuels. Factors affecting criticality safety are organization, expert advice, criticality assessment, training, process supervision, accounting, fuel movement within works, and dispatch and reception of fissile materials. Technical safety criteria are given. (AT)

17952 SYSTEM FOR HANDLING AND DISPENSING ^{133}Xe. Snyder, R. E.; Overton, T. R. (Univ. of Alberta, Edmonton). J. Nucl. Med.; 14: No. 1, 56-8(Jan 1973).

A handling and dispensing system has been developed which is capable of simultaneously dividing the contents of an ORNL shipment of ^{133}Xe into both a gas and an aqueous form. The ratio of gas to aqueous xenon is adjustable. A high transfer efficiency is achieved and high specific activity solutions are routinely available. Transferring and dispensing of curie quantities of radioactivity is relatively uncomplicated and the radiation dose to the operator during these procedures is small. (auth)

17953 METHOD FOR ACCELERATING THE COLLAPSE OF HIGH EXPANSION FOAM USED IN CERTAIN PROCESSES. Wilson, S. G.; Hughes, G. W. (to United Kingdom Atomic Energy Authority). British Patent 1,293,758. 25 Oct 1972. Filed date 31 Oct 1968. 2p.

In the method described the foam is passed into a region where it is subjected to mechanically induced collapsing forces derived from rotating blades. The apparatus comprises a duct through which the foam is passed, with a fan or rotor blade system at the downstream end to generate agitation and impact forces. Continuous breakdown of a stream of foam may be induced by causing it to enter a perforated drum of similar diameter to the feed duct, and rotated at 1500 to 3000 rpm. By using suitable baffles and shrouding around the periphery of the drum the separate gas and liquid phases emerging from the perforations can be collected, removed and processed as desired. The method may be applied to foams used for control of radioactive particulates and airborne radioactive liquid droplets. (UK)

Transportation

Refer also to abstract 17464.

17954 (ANCR-1100) PROTECTIVE SHIPPING PACKAGES FOR RADIOACTIVE AND FISSILE MATERIAL CONTAINERS. Tobias, D. A.; Nielsen, H. H.; Robinson, E. M. (Idaho Nuclear Corp., Idaho Falls). Mar 1968. Contract AT(10-1)1230. 45p. Dep. NTIS.

As of July 1, 1968, all shipments of radioactive and fissile material must be in containers which meet the Atomic Energy Commission and Department of Transportation requirements for Class II shipments. Recommendations to upgrade certain containers used by Idaho Nuclear Corporation from a Class III shipping category to a Class II category are presented. Engineering analysis, supported by physical testing, has led to the design of container enclosures that offer shock cushioning, fire resistance and thermal insulation conforming to the Class II category. (auth)

17955 (GADR-55(Rev.1)) FINAL DESIGN REPORT FOR FORT ST. VRAIN FUEL SHIPPING CASK WITH "AS-BUILT" INFORMATION. Davis, C. R.; Cocciolone, D. C.; Backus, H. A. (Gulf General Atomic Co., San Diego, Calif.). 5 Nov 1971. Contract AT(04-3)-633. 225p. Dep. NTIS.

The cask is designed for transporting six spent fuel elements at one time from the Fort St. Vrain Nuclear Generating Station to a nuclear fuel reprocessing facility. The spent fuel elements are hexagonal graphite blocks containing fissile material (primarily ^{233}U and ^{235}U) and fertile materials (primarily thorium). In addition, the cask may be used for the handling and transportation of radioactive reprocessed fuel. The cask tie-down system is designed for but not necessarily limited to public highway transportation equipment. The physical characteristics and operating procedures for loading and unloading the spent fuel container and fuel shipping cask at the Fort St. Vrain Nuclear Generating Station are given. Analysis of criticality, radiation

shielding, structural integrity and heat transfer is presented for both normal transit and hypothetical accident conditions in accordance with current AEC and Department of Transportation regulations. (TFD)

17956 SHIPPING CONTAINER FOR RADIOACTIVE MATERIAL USING SAFETY CLOSURE DEVICES. Bedrosian, P. H. (to Secretary of the Department of Health, Education, and Welfare). U. S. Patent 3,710,121. 9 Jan 1973. Filed date 13 Aug 1970. 8p.

A shipping container for radioactive materials is described which not only adequately shields the material from endangering a person handling it, but also protects the material during shipment. A series of interrelated, coacting components must be operated in a stepwise manner before the container can be properly and safely closed. (Official Gazette)

17957 ANALYSIS OF THE PRINCIPAL TECHNICAL PROBLEMS ENCOUNTERED IN THE MARITIME CARRIAGE OF RADIOACTIVE MATERIALS. Sousselier, Y. (CEN, Fontenay-aux-Roses, France). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 95, 6-10(May 1972). (In French).

The hazards presented by radioactive materials in different forms under normal shipping conditions, or in the case of an accident, were studied. The shielding used for normal shipping conditions is described; the resistance of the packaging in the case of an accident is evaluated and the practical construction of such packaging is discussed. The special problems associated with the release of heat, radiolysis, storage, and handling are mentioned. The following radioactive materials are likely to be transported by sea; uraniferous concentrates, UF_6, irradiated fuels, radioelements and isotope generators. (FR)

17958 PACKAGING CATEGORIES FOR THE TRANSPORTATION OF RADIOACTIVE MATERIALS. Roberti, M.; Susanna, A. (CNEN, Rome). Ig. Sanita Pubblica; 28: No. 1-2, 1-10(1972). (In Italian). (RT/PROT(72)16).

A statistical analysis is presented concerning packaging categories in the transport of radioactive materials. The analysis shows that the present categories of packages are not completely consistent with the actual situation in transport of radioactive materials, also with regard to radiation protection problems. In order to avoid this, a change of the present limits of Categories (I White, II Yellow, and III Yellow) was proposed at an international level. Such change, as shown by the statistical analysis, seems to be more consistent with the actual situation in the transport of radioactive materials, with better results also from the protection standpoint. (auth)

17959 CONTAINER FOR RADIOACTIVE MATERIALS HAVING A HEAT RELEASABLE OUTER PANEL WALL. Bochard, C. (to Robatel SLPI). U. S. Patent 3,711,715. 16 Jan 1973. Filed date 9 Feb 1971. 4p.

A container for radioactive materials is described comprising a chamber provided with a wall carrying outwardly projecting cooling elements such as fins. A casing is provided around the wall and means are provided for passing cooling fluid through the space between the wall and casing, which space contains the cooling elements. Preferably the casing comprises a plurality of panels secured to the wall but adapted to eject away from the container should the cooling air flow means fail. A preferred securing/ejection means comprises studs which melt on failure of the airflow means and springs ejecting the panels. (Official Gazette)

17960 RADIOACTIVE CONTAMINATION OF THE SURFACES OF PARCELS AND VEHICLES TRANSPORTING RADIOACTIVE MATERIALS. Redon, A. (CEA, Paris). pp 655-66 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

The IAEA recommendations on the permissible contamination levels of surfaces are reviewed: fixed and nonfixed contamination; transferable contamination. Problems encountered with large packages for the transport of irradiated fuels are presented. Three important problems arise: the control of the internal contamination on arrival at the unloading site; the control and decontamination at the loading site; the comparison of measurements made on receipt of the package with those made at its dispatch. In this way, phenomena due to the reappearance of concealed radioactive material can be checked. (France)

17961 HEALTH PHYSICS ORGANIZATION AND RADIOACTIVE TRANSPORT IN ITALY. Roberti, M.; Susanna, A.; Zampini, F. (CNEN, Rome). pp 667-76 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Following the construction of many power and research reactors and the use of radioisotopes, the transport of radioactive materials has undergone remarkable developments during the last few years. Now that sufficient experimental data are available, the problems involved can be solved more logically. Appropriate regulations have been put forward on the basis of general recommendations established from both the administrative and the technical point of view. In addition, the experience gained in Health Physics problems has led to more realistic technical recommendations concerning transport methods or Health Physics devices. In particular, the maximum hypothetical accident is no longer analyzed in each case; on the contrary, in agreement with international recommendations, emphasis is put on the containers and their testing and special precautions are only taken when these tests are judged not to comply with IAEA regulations. In recent years the Health Physics problems have become increasingly a question of checking that the tests carried out on the containers relate to the type of accident liable to occur during transport. It has been proved statistically that the doses received in transport are negligible which means that with a few rare exceptions the workers engaged have been transferred to the class of workers not directly engaged in radiation work. (France)

17962 LEAD SHIELDING CALCULATIONS FOR TRANSPORT CONTAINERS FOR COMMONLY USED RADIOISOTOPES. Shaikh, M. U. (Pakistan Inst. of Nuclear Science and Tech. Rawalpindi). Nucl. Eng. Des.; 23: No. 2, 228-234(1972).

Calculations were made of the lead shield thickness required for the safe transport of ^{198}Au, ^{82}Br, ^{137}Cs, ^{60}Co, ^{51}Cr, ^{64}Cu, ^{203}Hg, ^{131}I, ^{192}Ir, ^{42}K, ^{24}Na, ^{46}Sc, ^{85}Sr and ^{65}Zn, reactor-produced radionuclides useful as tracers, etc. These calculations are in accordance with the criteria laid down by the IAEA and the USAEC. The exposure rate in mr/hr at 1 m for a point source of a given radionuclide shielded by various thicknesses of lead were computed by summing the contribution to the exposure rate by each gamma energy contained in the decay scheme of the radionuclide concerned. Using the relationship of Morgan and Turner for the exposure rate, and interpolated dose build-up factors, the activity of the radionuclide which gives an exposure rate of 10 mr/hr at 1 meter from the source has been tabulated for the corresponding lead shield thickness. (auth)

17963 REGULATIONS CONCERNING THE MARITIME CARRIAGE OF RADIOACTIVE MATERIALS. Redon, A. (CEA, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 95, 11-14 (May 1972). (In French).

The various regulations applicable in France to the different stages involved in the marine transport chain are examined, e.g., handling, charging, and discharging; accidents occurring on board a ship in port; and decontamination. The experience acquired in the field of marine transport concerns materials with low specific activities, (UF_6 in special cylinders and chemical concentrates in industrial type packages), large sources, and fissile materials contained in package approved by the authorities. Emphasis is given to the responsibilities of the shipper, the carrier, and the handling enterprises. (France)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 17249 and 18251.

17964 (RHEL/R-263) NIMROD OPERATION AND DEVELOPMENT. Quarterly report, July 1 – September 30, 1972. Gray, D.E. (ed.) (Rutherford High Energy Lab., Chilton (England)). 10p. Dep. NTIS (U.S. Sales Only). UK 15 pence.

The Nimrod beam was on for High Energy Physics Research for 89% of HEP scheduled operating time. Four experiments were completed, five were continued, and one began in the quarter. Details of new beams and modifications to existing beams in Nimrod's experimental halls in 1973 are given. Some statistics relating to personal radiation dosimetry are presented. (auth)

17965 DEVELOPMENTS IN ACCELERATING MACHINES FOR NUCLEAR STRUCTURE RESEARCH. Titterton, E. W. (Australian National Univ., Canberra). pp 164-76 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The history of tandem accelerators and synchrocyclotrons and AVF cyclotrons is briefly reviewed. The accelerating machine complex at the Australian National University is described, including the 38-MeV Cyclo-Graaff system and the 14UD Pelletron accelerator. (5 figures) (RWR)

17966 GENERATOR OF ROTATING RELATIVISTIC ELECTRON RING-FORM BUNDLES. Levin, M. L.; Mints, A. L.; Naumenko, E. D. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR; 204: No. 4, 840-3(1 Jun 1972). (In Russian).

Generators of the Pierce–Harris electron gun-type and the magnetic gun-type capable of producing rotating relativistic electron ring-form bundles are described. Construction and operation of one of these generators is discussed, with a tabulation of the main operating specifications. (KSW)

17967 ACTIVATION OF SYNCHROCYCLOTRON COOLING WATER. Komochkov, M. M.; Teterev, Yu. G. At. Energ. (USSR); 34: No. 1, 17-22(Jan 1973). (In Russian).

The concentration of γ-active isotopes in synchrocyclotron cooling water was studied, and γ levels near the cooling system were measured. The activity of γ-active isotopes was measured by means of NaI(Tl) and Ge(Li) spectrometers. In the water of the cooling system there were found long-lived isotopes which are products of corrosion of the cooling system material. The activity of these isotopes is commensurable with the activity of ^{7}Be, produced from the oxygen of the water. The concentration of radioisotopes in the water is determined not only by the intensity of the accelerated protons and half-life periods but also by the sorption and desorption processes on the cooling system walls. Therefore, the equilibrium γ-activity of the long-lived isotopes ($T_{1/2}$ > 6 days) is reached during 6 days independently of isotope half-lives. The formulas presented for calculating induced radioactivity were obtained on the basis of observed regularities of radioisotope build-up in the water of the cooling system. (auth)

17968 METHOD FOR THE ACCELERATION OF IONS IN LINEAR ACCELERATORS AND A LINEAR ACCELERATOR FOR THE REALIZATION OF THIS METHOD. Bomko, V. A.; Revutskii, E. I.; Rudiak, B. I.; Pipa, A. V. U. S. Patent 3,710,163. 9 Jan 1973. Filed 2 Feb 1971.

The method for the acceleration of ions in linear accelerators consisting of a cavity resonator and drift tubes employing a standing r.f. electromagnetic wave, according to the invention, is characterized in that the resonator is excited in the E_{011} mode enabling the energy of the accelerated-ion beam to be controlled continuously by establishing a region with a uniform distribution of the accelerating field and by varying the extent of that region. This method can be realized by a linear accelerator comprising a cavity resonator with drift tubes; tuners arranged on the side wall of the resonator; and an additional tuning means made in the form of a conducting post installed in an end wall of the resonator near its side wall parallel with the axis of the resonator and capable of being moved along that axis. (Official Gazette)

17969 JAERI'S REMODELED LINEAR ACCELERATOR. At. Jap.; 16: No. 9, 17-25(Sep 1972).

Japan has installed four electron linear accelerators of medium size and all are now in operation. The first is a 300-MeV machine at Tohoku University, the second a 33-MeV machine of the Electrotechnical Laboratory, the third a 42-MeV machine of Kyoto University, and the fourth is a new 180-MeV machine of Japan Atomic Energy Research Institute (JAERI). The main research program is the use of the new linacs to obtain nuclear data needed for the development of nuclear reactors, and to do research in associated fields on the basis of this development. The rate of neutron production of the new linac is about 1,000 times as high as that of an old machine, so that measurement of high accuracy can be made on various neutron cross-sections, especially the measurement in keV-region, that has been most urgently needed for the fast breeder reactor experiment. The pulse width of the electron beam is from 0.01 to 2 microseconds, and that of current amplitude is from 5 amperes to dark current, and repetition rate of the pulse is from 1 to 600 pulses/s. Neutron and nuclear physics experiments with the linac require very fast acquisition and reduction of multiparameter-multichannel data, and more than two independent experiments are to be performed in parallel. To meet this requirement, an on-line computer system was installed at the linac laboratory. (JA)

17970 CONTINUOUSLY COOLED SUPERCONDUCTING LINEAR ACCELERATOR AND PARTICLE-SEPARATOR MODELS AT 4.4 AND 2°K. Herz, W.; Winkler, G. (Kernforschungszentrum, Karlsruhe, Ger.). Advan. Cryog. Eng.; 17: 224-9(1972).

The development of a prototype linear accelerator for protons of 60 MeV and a radiofrequency particle separator is described. The prototype accelerator will be composed of a 10-meter helix type structure for acceleration from 0.8- to 20-MeV, running at 90 MHz, and a 15-meter disc-loaded type structure at 720 MHz for acceleration to the final energy of 60 MeV. The particle separator which is provided for K–π meson separation in the 10-GeV range at the CERN 28-GeV proton synchrotron, consists of two deflectors arranged in series to be installed at a distance of 20 or 50 meters. (WHK)

Auxiliaries and Components

Refer also to abstract 18637.

17971 (AECL-4153) ANALYSIS OF VACUUM TRANSIENTS IN A LINAC. Bayly, J. G.; Selander, W. N. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1972. 33p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

A nonlinear diffusion equation describing the pressure transient that occurs within an evacuated pipe following a puncture is derived and a solution valid for small values of the time is obtained. This is of interest in analyzing the initial stages of a vacuum transient in a large linear accelerator, and may be a factor in the choice and location of fast isolating valves. (auth)

17972 (KFK-1644) SYSTEM FOR CONTROL AND INTERACTIVE DATA REDUCTION FOR A MAGNETIC FIELD MEASURING ARRANGEMENT. Brandes, J.; Ulbricht, A. (Kernforschungszentrum, Karlsruhe (West Germany)). Aug 1972. 46p. Dep. NTIS (U. S. Sales Only).

The program system for a magnetic field measuring system for accelerator magnets and beam transport and bending magnets which has been in operation for two years is described. The experimental system is connected via data channels to a TR-86-A computer and utilizes an operating system for multi-access serving also several other experiments. The program system is divided into two modules, one module consists of data acquisition and control routines and the other consists of the evaluation routines for interactive data reduction. The control routines are used for point-to-point measurements of magnetic fields and to drive a field sensor along straight lines and circles and across flat planes and cylindrical surfaces. The evaluation routines calculate and display physical parameters and relations such as magnetic field strengths as a function of sensor position or differentiated and integrated measured curves. Several applications of the control and evaluation routines to tests of device components, to measurements of field distributions of dipole and quadrupole magnets and excitation curves illustrate the degree of automatic data acquisition and analysis. (auth)

17973 (LYCEN-7257) THEORETICAL INTERPRETATION OF THE CHARACTERISTICS OF INTERDIGITAL STRUCTURES. Chabert, A.; Voisin, G. (Lyon Univ., (France). Institut de Physique Nucleaire). Sep 1972. 31p. (In French). Dep. NTIS (U.S. Sales Only).

An outline of the method adopted to investigate the interdigital linac structure is given. The results obtained on the dispersive properties, the fields, and the characteristics of the structure are presented together with the experimental results in view of testing the validity of the model and the convergence of the calculations. The theoretical and experimental dispersion curves are in agreement. The accuracy obtained for the fields and electrical properties is inferior to that obtained for these curves. (France)

17974 (RPP/A-94) GFUN: AN INTERACTIVE PROGRAM AS AN AID TO MAGNET DESIGN. Newman, M.J.; Trowbridge, C.W.; Turner, L.R. (Rutherford High Energy Lab., Chilton (England)). Sep 1972. 10p. (CONF-720908-34). Dep. NTIS (U.S. Sales Only). From 4th International Conference on Magnet Technology; Upton, New York, United States of America (USA) (19 Sep 1972).

A new package of programs, called GFUN, has been developed for designing and calculating the fields of two-dimensional and three-dimensional magnets. The field due to the magnetization of the iron is calculated directly. DRAW subprograms simplify the input of data for the iron and current regions, and display a picture of the iron and current elements for checking as they are read in. GETB subprograms allow the field at a point, along a line or over a region to be typed, graphed or contoured. Automatic optimization is provided. GFUN results have been checked against TRIM calculations and against the measured fields of existing magnets. The use of GFUN for several magnets currently being designed at the Rutherford Laboratory is discussed. (auth)

17975 SHIELDING DOOR INTERLOCK 10 M.E.V. TANDEM VAN DE GRAAFF (Aug 1972) (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1293).

6 drawings.

17976 FINDING OUT ABOUT FERRITES. Arnaud, C.; Bargmann, H.; Kindermann, H. P.; (and others). CERN Cour.; 12: No. 11, 364-367(Nov 1972).

Research on ferrites for use in accelerator rf cavities is reported. Topics include electrical, mechanical and vacuum problems. (WHK)

17977 HANDLING HIGH VOLTAGES. A. VOLTAGE HOLDING IN VACUUM. Rohrbach, F. CERN Cour.; 12: No. 11, 374(Nov 1972).

Research at CERN on voltage holding in vacuum to obtain good performance from the high-voltage pre-injector of the proton synchrotron and to achieve high-quality separated beams of secondary particles is summarized. (WHK)

17978 REFRIGERATORS FOR SUPERCONDUCTING ACCELERATORS AND AUXILIARY EXPERIMENTAL EQUIPMENT. Hall, F. F. (Stanford Linear Accelerator Center, CA). Advan. Cryog. Eng.; 17: 230-9(1972).

Research on refrigerators for the proposed conversion of the Stanford Linear Accelerator to superconducting operation is described. Sixteen refrigerators are required to intercept heat leakage from ambient and remove rf and electron beam heat losses from the liquid helium in the accelerator dewars. Aspects of the basic refrigeration cycle are discussed in detail. (WHK)

17979 DIODE-SCANNER-RECORDER SYSTEM FOR MONITORING OPERATING PARAMETERS OF A LINEAR ACCELERATOR. Wright, A. E.; Gager, L. D. (Baylor Univ., Houston, TX). Phys. Med. Biol.; 18: No. 1, 138-141(Jan 1973).

An outline description is given of a diode-scanner-recorder system, used as a rapid check on parameters such as beam energy and intensity, both clinically significant for the use of linear accelerators in radiotherapy. The diffused p-n junction silicon diode is a $1 \times 1 \times 0.1$ mm plate and is connected to a current to voltage electrometer amplifier. The probe output is about 50 pA rad^{-1} min^{-1}. The response of the probe is essentially instantaneous, so that a trace of the output across a large field can be accurately plotted in less than a minute. The signal is dose rate independent, but the dose response is significantly energy dependent below ~200 kV and corrections must be made when used for in depth measurement. The probe and scanner were interfaced to an X-YY′ recorder. The apparatus has also shown itself valuable for accelerator systems tuning following replacement of major components and for detecting the onset of magnetron failure. (UK)

17980 DESIGN OF THE RF SYSTEM FOR THE TRIUMF CYCLOTRON. Prochazka, A. Vancouver, British Columbia; Univ. of British Columbia (1972). National Library of Canada, Ottawa.

Thesis (Ph.D.)

The basic design of the resonator system, coupling loop assembly and the resonant transmission line for the TRIUMF isochronous cyclotron was studied in detail and the beam-resonator RF field interaction estimated using a simple model. The matching techniques which will allow a maximum power transfer from the power tube stage to the dees are discussed. Two major computer programs have been written and are used to determine the parameters of the rf system necessary in order to obtain a desired impedance match and to find the various resonant frequencies of the rf system. The results of a large number of experimental tests carried out in order to verify the resonator electrical characteristics, to investigate the resonator frequency tuning and the resonator mechanical construction around the center post, and to apply the proposed matching technique to the TRIUMF rf system, are given. The results from the prototype resonator segments and the transmission line tested at high power both in air and under high vacuum indicate that the rf system performance is compatible with the cyclotron operation. (Diss. Abstr. Int., B.)

Ion Sources and Injection and Extraction Systems

17981 (IFVE-SKU-71-63) APPLICATION OF NONLINEAR RESONANCES OF BETATRON OSCILLATIONS IN SLOW PARTICLE EXTRACTION FROM THE ACCELERATOR WITH STRONG FOCUSING. Fedotov, Yu. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 27p. (In Russian). INIS.

A theoretical investigation of the dynamics of nonlinear resonances was conducted from the point of view of utilizing them for the slow extraction of particles from an accelerator having strong focusing. Formulas were employed which were suitable for calculating the basic parameters of a system for slow extraction including resonance harmonic values, resonance band widths, emittance of the extracted beam, and phase trajectory. Examples are presented of the calculation for the 70-GeV IHEP Accelerator. (tr-auth)

17982 (LA-tr-73-1) PRODUCTION OF AN INTENSE H^- ION BEAM FROM A DISCHARGE IN CROSSED FIELDS. Translated by Anna Vakar (Los Alamos Scientific Lab., N. Mex.) from IYAF-62-72. Dec 1972. 17p. Dep. NTIS.

Extraction of negative hydrogen ions from a high-current discharge in crossed fields and in a "planotron" geometry in a pulsed regime was investigated. H^- ions were extracted across the magnetic field through a slit in the anode, positioned perpendicular to the magnetic field. Such a slit position reduces the accompanying electron current, reduces the size of the source, and permits variation of the slit length in a broad range without changing the source operating regime. A special magnetic field configuration makes possible fast electron discharge onto a collecting electrode. Near the emission slit, fast negative ions from the discharge are transformed into slow H^- ions from which the beam is formed. In the beam energy spectrum a group of H^- ions desorbed from the cathode is found. The H^- ion beam current and the current of the accompanying electrons are proportional to the slit length. With a 1×10 mm slit, an H^- ion beam intensity up to 22 mA is obtained, with an electron current of not more than 100 mA. (auth)

17983 CAPTURE EFFICIENCY DURING THE INJECTION OF A BEAM BUNCHED AT THE FREQUENCY OF THE ACCELERATING RESONATORS OF A SYNCHROTRON. Esin, S. K.; Petrosyan, M. L.; Serov, V. L. At. Energ. (USSR); 33: No. 6, 998-1000(Dec 1972). (In Russian).

The efficiency of capture of injected particles in a synchrotron is increased significantly by bunching when the bunching device is excited at the frequency of operation of the accelerating resonators of the synchrotron. The value of the accelerating current in a synchrotron was measured relative to the first revolution for up to 19 revolutions, subject to the conditions: without a bunching device, with the first, the second, and with both resonators. The accelerating current was also studied as a function of the voltage phase of the bunching device. (KSW)

17984 HANDLING HIGH VOLTAGES. B. APPLICATION IN ELECTROSTATIC SEPTUMS. Germain, C. CERN Cour.; 12: No. 11, 375-378(Nov 1972).

The development of electrostatic systems at CERN is reviewed, and the operation and performance of the electrostatic septum used in the slow ejection system of the CERN 28-GeV synchrotron are discussed. (WHK)

Ion Optics and Field Calculations

17985 (INS-J-138) ORBIT ANALYSIS OF THE 107 CM MODEL MAGNET FOR THE 176 CM SF CYCLOTRON. Tanabe,

T.; Yamazaki, T.; Sekiguchi, M.; Ogawa, H.; Furuya, M.; Sakurada, Y.; Yamada, T.; Fujita, M.; Honma, T.; Hirao, Y. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 27 Nov 1972. 46p. Dep. NTIS (U. S. Sales Only).

Magnetic field calculations using the 107-cm model magnet of the 176-cm variable-energy, multi-particle sector focused cyclotron are discussed. Detailed information concerning the orbit properties was obtained by numerical integration of differential equations representing the particle orbit using the field data of the model magnet, and the results are described. TOSBAC-3400 of INS and HITAC-5020E of the Computer Center of Univ. of Tokyo were used for the numerical calculations. (WHK)

17986 (UCRL-Trans-1489) STABILITY OF A SCREENED RING ON DISPLACEMENT OF ITS CENTER. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated for Univ. of California, Lawrence Berkeley Lab., Berkeley, from Report JINR-P9-6514. Jun 1972. 17p. Dep. NTIS.

It has been shown that during the motion of a charged electron ring with current coaxially with a screening metallic tube the particles within the ring can be focused in the direction of motion. For a screen having an anisotropic conductivity, ensuring maximal screening of the electric field and free penetration of the magnetic field into the medium, the focusing action of the screening tube increases. The stability of the ring when its center is displaced in relation to the tube axis was investigated. It was assumed that the ring did not change its shape on displacement and that the deviations of the particles from the equilibrium orbit were small. (auth)

17987 ENERGY SPREAD OF ELECTRONS IN THE MAGNETIC FIELD OF A BETATRON. Evstigneev, V. V.; Kashkovskii, V. V.; Milyutin, G. V. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 129-131(1972). (In Russian).

A quantitative relation between the energy spread of electrons and the parameters of a betatron was sought from theoretical considerations. The nonrelativistic case was considered primarily; the result was valid for the beginning of the process of electron acceleration in a betatron. A method is suggested for determining the energy spread for the region of relativistic energies. (KSW)

17988 EFFECT OF SYNCHROTRON RADIATION OF BETATRON AND PHASE OSCILLATIONS OF ELECTRONS IN A SYNCHROTRON. Kozhevnikov, A. V.; Nikitin, M. M. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 104-106(1972). (In Russian).

It has been recognized that synchrotron radiation in cyclic electron accelerators affects the dynamics of electrons. The amplitude of phase and radial oscillations of electrons was measured experimentally; the square of the amplitude of the radial oscillations caused by the quantum build-up exceeded by a factor of two the analogous quantity obtained when only the betatron oscillations were considered. (KSW)

17989 NOTE ON THE STRUCTURE OF THE MAGNETIC FIELD IN A SPLIT-MAGNET SECTOR-FOCUSED CYCLOTRON. Katsaurov, L. N.; Moroz, E. M.; Nechaeva, L. P. This paper was summarized in At. Energ. (USSR); 31: No. 5, 511-512(Nov 1971) as paper No. 542/6192. (In Russian).

Full copy of this paper is held by TIC.

Information is presented on the distribution pattern of the magnetic field in the sector-focused cyclotron of FIAN [Lebedev Institute of Physics of the Academy of Sciences of the USSR]. The possibility of replacing the real distribution by a model of a stepwise distribution of the magnetic field, for the purpose of utilizing familiar formulas for computing the principal characteristics of the motion of particles in the cyclotron (geometry and position of equilibrium trajectories, cyclotron frequency and betatron frequency and the radial variation of those frequencies, and so forth), is discussed. This procedure enables one to obviate the problem of excessive reliance on computer data processing in the design of this type of cyclotron, even in some cases of simulation design since the magnetic field of such a cyclotron can be computed to within 1 to 2%, and its parameters can be computed on the basis of formulas cited. This means that comparatively simple and straightforward calculations can be relied upon to find the arrangement of magnets capable of forming the cyclotron's magnetic field with all the necessary basic parameters meeting specifications. (WHK)

17990 TRAJECTORIES OF PARTICLES IN AN ISOCHRONOUS CYCLOTRON IN THE PRESENCE OF ACCELERATION. III. Khokhlov, Yu. K. This paper was summarized in At. Energ. (USSR); 31: No. 6, 626(Dec 1971) as paper No. 553/6252. (In Russian).

Full copy of this paper is held by TIC.

In choosing the geometry of the dees for a projected cyclotron, one must be certain that the electric field of the gaps will not shift the frequency of the radial betatron oscillations in the region of the parametrical resonance $\nu_x = 1$. In conjunction with this, the experiment examines two primary mechanisms of the influence of the gaps on ν_x: (a) the effect, which is determined by relative increase of kinetic energy, $\Delta W/W$, and (b) the effect, which is defined by the rate of change in the increase of ΔW at the moment of the crossing of the gap by the trajectory of the center of the bunch, $\epsilon = (\Delta W)\cdot/\omega_c$. The influence of the factors $\Delta W/W$ and ϵ/W on the frequency ν_x is examined in linear and quadratic approximations. It is shown that as a consequence of the symmetrical orientation of the dee system relative to the magnetic system, the corrections linear in $\Delta W/W$ to SpM $(\pi/0)$ are equal to zero. In the case of strictly isochronous movement of particles, the corrections linear in ϵ/W are also equal to zero. Corrections quadratic in $\Delta W/W$ decompose, in turn, into focusing orbital corrections and defocusing boundary corrections. The sum of these corrections has a rather quickly focusing character, i.e., shifts the frequency ν_x to the side from the dangerous value $\nu_x = 1$. The correction quadratic in ϵ/W has a purely defocusing character, i.e., in principle can be examined as a possible cause of parametrical resonance or pulsation. However, the numerical value of this correction is very small (and quickly decreases with an increase of energy). Thus, the conclusion is drawn that in a cyclotron of the type described, the factors $\Delta W/W$ and ϵ/W do not represent a real danger. (auth)

Storage Rings

17991 MUCH ADO ABOUT NOTHING. THE VACUUM SYSTEM OF THE ISR. Calder, R. CERN Cour.; 12: No. 11, 359-362(Nov 1972).

Problems encountered in developing the vacuum system for the CERN ISR (10^{-10} to 10^{-11} torr) are discussed. Topics include sources of gas, cryopumping, measuring very low pressures, and beam-induced vacuum problems. (WHK)

Experimental Facilities

Refer also to abstracts 17393, 17422, 17970, 18242, 18653, and 18657.

17992 (BNL-17570) AGS SECONDARY BEAMS AND PARAMETERS, FY 73. Wang, C.L.; Berley, D. (Brookhaven National Lab., Upton, NY). 19 Oct 1972. 15p. Dep. NTIS.

A compilation is presented of the AGS secondary beam parameters and fluxes. (auth)

17993 (FRNC-TH-302) COMPARISON OF THE CHARACTERISTICS OF METALLIC TARGETS AND D_2O OR T_2O TARGETS USED TO PRODUCE NEUTRONS BY (d, d) OR (d, t) REACTIONS AT LOW ENERGIES (0 TO 130 kV). Ngo Van Hai (Paris Univ., Orsay (France)). 1972. 111p. (In French). Dep. NTIS (U.S. Sales Only).

Thesis.

It was demonstrated that the depletion of the deuterated or tritiated metallic targets usually employed depends on the sputtering of the Ti film by the accelerated deuterons in addition to temperature and impurity effects. A target in the form of D_2O or T_2O vapor was considered, such a target functioning by the continuous replacement of the target atoms from the evaporation of the deuterated or tritiated water. It was shown that a mixture of gaseous molecules and liquid droplets exists in the target vapor cloud (these droplets being formed as a result of the expansion of the vapor). This target enables a high atomic density to be continuously maintained in spite of the low pressure in the accelerator channel. The stopping power of D_2O and T_2O target nuclei was compared to that of Ti-D and Ti-T metallic targets: the D_2O and T_2O targets present the smaller stopping power. The neutron yield of the vapor targets is higher, this fact being suggested by the theory and verified by experiment. (France)

17994 (IFVE-SEF-71-86) TIME-OF-FLIGHT SPECTROMETERS FOR EXPERIMENTS ON SEARCH FOR HEAVY PARTICLES AND ANTINUCLEI AT THE IHEP 70-GeV PROTON SYNCHROTRON. Vishnevskii, N. K.; Grachev, M. I.; Karpov, I. I.; Lapshin, V. G.; Ronzhin, A. I.; Rykalin, V. I.; Solyanik, V. I.; Khromov, V. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 38p. (In Russian). INIS.

A time-of-flight spectrometer is described which may be used in a search for quarks, the study of antideuterons, the observa-

tion of antihelium, and the investigation of heavy particles and antinuclei. The results of measurements in connection with heavy particles are presented. The circuitry of the spectrometer and the operation of its subassemblies are discussed: an amplitude-compensation for impulse-forming, a time interval comparison circuit, and a calibration circuit. The resolution time (2τ) of the spectrometer was about 0.2 to 0.4 nsec. (tr-auth)

17995 (LBL-798) DIGITIZING ELECTRONICS FOR THE EMI MULTI-WIRE PROPORTIONAL CHAMBERS. Binnall, E.; Kirsten, F.; Lee, K.; Nunnally, C. (California Univ., Berkeley. Lawrence Berkeley Lab). Dec 1972. Contract W-7405-eng-48. 18p. (CONF-721202-11). Dep. NTIS.

From Nuclear Science Symposium; Miami Beach, Florida, United States of America (USA) (6 Dec 1972).

A complete system of electronics for digitizing pulses from a large array of multi-wire proportional counters is described. The system is based on the method of coupling the chamber pulses onto delay lines developed by Perez-Mendez. All three wire planes of each chamber are digitized, giving positional information for each avalanche in the chamber on three coordinates, x, y and a redundant coordinate. The system will be used with an array of 30 chambers each one meter square, which will serve as an External Muon Identifier (EMI) for the 15-foot diameter bubble chamber in the neutrino beam line at NAL. Up to 16 events can be digitized in a 60 μs beam spill. (auth)

17996 VACUUM CHANNEL OF AN NG-150 NEUTRON GENERATOR. Saksaganskii, G. L.; Serebrennikov, D. V.; Tsepakin, S. G. (Scientific-Research Inst. of Electrophysical Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 809-812(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 166-169(1972).

The vacuum system of an NG-150 neutron generator is described. Analytic dependences are given for calculating the pressure distribution over the beam path and the results of calculation. Operating experience is described, and data are presented on the reliability of the vacuum system of the neutron generator. (auth)

17997 DISTRIBUTION OF DEPTH DOSES OF BETATRON B5M-25 BREMSSTRAHLUNG IRRADIATION. Kozlov, A. P.; Bazhanov, E. B.; Dimov, V. I.; Terpugov, V. G.; Shitov, V. A. (Inst. of Oncology, Leningrad). Med. Radiol.; 17: No. 7, 72-6(Jul 1972). (In Russian).

An investigation was carried out on the ionization distribution along the beam axis of the bremsstrahlung radiation of the medical Betatron B5M-25 within the maximal energy range of E = 12 to 27 for a number of radiation fields of different sizes and configurations with several DIB values. There have been defined some regularities in the changes of maximal ionization areas with changes of DIB and Maximal E and in the relation between the depth-dose curves and the size of radiation fields. Some characteristics of isodose curve families are given as well. The results obtained can be used in calculations when selecting optimal plans for therapy. (auth)

17998 NEUTRONS FROM THE BOMBARDMENT OF BERYLLIUM BY DEUTERONS. Weaver, K. A.; Anderson, J. D.; Barschall, H. H.; Davis, J. C. (Univ. of Wisconsin, Madison). Phys. Med. Biol.; 18: No. 1, 64-70(Jan 1973).

Fast neutron spectra produced by the bombardment of thin and thick beryllium targets with deuterons have been measured at incident energies between 3 and 18 MeV. Total neutron yields and average neutron energies were determined from the data. The purpose of the measurements was to provide information from which dose rates and depth dose can be calculated for various conditions encountered in neutron radiotherapy with cyclotrons. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 18304, 18307, 18313, 18317, and 18328.

17999 (LUIP-CR-72-16) COMPOSITION OF LOW ENERGY COSMIC RADIATION FROM SILICON TO NICKEL. Soederstroem, K.; Lindstam, S.; Behrnetz, S.; Kristiansson, K. (Lund Univ., (Sweden). Dept. of Physics). Dec 1972. 28p. Dep. NTIS (U.S. Sales Only).

The charge composition of the cosmic radiation for the elements with $Z \geq 14$ has been studied in a stack of nuclear emulsions exposed at Fort Churchill in July 1967. Particles stopping in the stack have been measured with a nuclear track photometer to determine the charge. Relative abundances are given for the elements silicon to nickel and comparison is made with other investigations. (auth)

18000 (NP-19650) SOLAR DIURNAL AND SEMIDIURNAL VARIATIONS IN THE COSMIC RAY NM-DATA 1965–69 RECORDED IN BERGEN. Technical Report 48. Aksland, A. M.; Amundsen, R. (Bergen Univ. (Norway). Dept. of Physics). Nov 1972. 15p. Dep. NTIS (U. S. Sales Only).

Methods of analysis applied to the study of the solar diurnal and semidiurnal variations in cosmic-ray neutron monitor data are outlined, and the results from 1965–69 for the Bergen neutron monitor are presented and related to findings obtained by other groups. The results based on the Bergen NM data yield amplitudes and phases of 0.344% and 0.045%, and about 18h and 3h, respectively, for the first and second harmonics. The findings compare nicely with the functional relations found by Rao from a world-wide network of stations. The two-component diurnal variation found by Forbush from ion chamber data is not present in our NM data. The theoretical state of affairs as to the explanations of the diurnal and semidiurnal effects is stated. (auth)

18001 ELECTROMAGNETIC INTERACTIONS OF COSMIC RAY MUONS IN IRON. 1. Search for a Charge Asymmetry. Grupen, C.; Hamdan, M. A.; Hansen, S.; (and others) (Durham Univ., Eng.). J. Phys., A (London); 5: No. 12, 1706-1712(Dec 1972).

A search for a charge asymmetry in the interactions of cosmic-ray muons in iron has been made using the Durham spectrograph MARS. The measurements cover the range of muon energy 6 to 200 GeV and refer to interaction secondaries varying in number from one to about 20. The ratio of the interaction probability for positive muons to that for negative muons is 1.08 ± 0.06 for interactions having two or more secondaries. This value is less than that found in some previous experiments and does not give support to the existence of a charge asymmetry. (auth)

18002 ELECTROMAGNETIC INTERACTIONS OF COSMIC RAY MUONS IN IRON. 2. Momentum Dependence of the Interaction Probabilities. Grupen, C.; Hamdan, M. A.; Hansen, S.; (and others) (Durham Univ., Eng.). J. Phys., A (London); 5: No. 12, 1713-1721(Dec 1972).

The Durham spectrograph MARS has been used to study the electromagnetic interactions of cosmic-ray muons in iron in the energy range 6 to 200 GeV. The interaction probabilities for producing single electrons and electron bursts of various sizes from the knock-on process, direct electron pair production and bremsstrahlung are investigated as a function of muon energy. Reasonable agreement between the measured probabilities and those predicted has been found and it is concluded that significant deviations from accepted theory are not likely. (auth)

18003 DEUTERONS AND ^{3}He FORMATION AND DESTRUCTION IN PROTON INDUCED SPALLATION OF LIGHT NUCLEI ($Z \leq 8$). Meyer, J. P. (CEN de Saclay, Gif-sur-Yvette, France). Astron. Astrophys., Suppl. Ser.; 7: No. 4,417-467(Dec 1972).

With the aim of interpreting the deuteron and ^{3}He abundances in galactic cosmic radiation, a survey was made of (i) their production cross sections and reaction kinematics in p–p, p–^{3}He, p–^{4}He, and p–(CNO) interactions, with special emphasis on the p–^{4}He reactions, (ii) their destruction cross sections in p–d and p–^{3}He reactions, and (iii) the p–p, p–d, and p–^{4}He elastic scattering cross sections. The experimental data are thoroughly discussed and the "neutron data" reinterpreted in terms of the mirror proton induced reaction. Whenever reliable observations are lacking, tentative extrapolations were made, based on (i) expected similarities with the nucleon–nucleon cross sections behavior, and (ii) the need for consistency with the total and the inelastic cross sections. (auth)

18004 MAGNETOHYDRODYNAMICS AND PLASMA PHYSICS OF THE SOLAR CORONA. Meyer, F. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). (Astrophys. Space Sci. Libr.) 27: 29-35(1971).

From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).

See CONF-700983-.

18005 OBSERVATIONS ON LOW-ENERGY LIGHT AND MEDIUM NUCLEI IN THE PRIMARY COSMIC RADIATION. Tamai, E.; Narita, N. (Nihon Univ., Chiba, Japan). Nihon Daigaku Seisan Kogakubu Hokoku; 4: No. 2, 133 137(Sep 1971). (In Japanese).

In balloon experiments flown at Fort Churchill, Canada in July 1965, nuclear emulsion stacks were used to study the fluxes and the charge composition of light ($3 \leq Z \leq 5$) and medium (M) nuclei of $6 \leq Z \leq 9$) nuclei in the primary cosmic rays above the atmosphere in the region of kinetic energy from 90 to 300 MeV/N. The results show a flux ratio for light (L) to medium (M) nuclei of 0.38 ± 0.10 in the 115- to 285-MeV/N interval. The ratio provides an estimate of the amount of interstellar matter traversed by the low-energy cosmic radiation, and this estimated value is compared with that from the ^{3}He nuclei abundance which was measured in a previous experiment. The elemental structures of the L and M nuclei were also obtained. (auth)

18006 COSMIC RAY MUON CHARGE RATIO. Granoff, M. E. San Diego, CA; Univ. of California (1972). 143p. University Microfilms Order No. 73-861.

Thesis (Ph. D.).

The cosmic-ray muon integral charge ratio was measured at muon energies up to 1000 GeV using a very large solid-angle area magnetic spectrometer which employed wire spark chambers. Based on the analysis of 425 events with measured energies greater than 1000 GeV, it was found that the cosmic-ray muon integral charge ratio at 1000 GeV was 1.35 ± 0.13. This result is based on having analyzed more events using a magnetic spectrometer with a maximum detectable momentum greater than 1000 GeV/c than has been previously reported. (Diss. Abstr. Int., B)

18007 POLARIZATION OF COSMIC-RAY MUONS. Tuner, R. J. New Haven; Yale Univ. (1972). 56p. University Microfilms Order No. 73-377.

Thesis (Ph. D.).

The polarization of cosmic-ray muons arriving at sea level with different energies and from different zenith angles was measured. The polarization of positive muons from the zenith with energies near 1.0 GeV was found to be -0.33 ± 0.04, where the polarization in the direction of flight was measured and the negative sign indicated that the spin was antiparallel to the direction of flight. Muons from the zenith with energies near 3.5 GeV at sea level had polarizations of -0.38 ± 0.04, and the polarization of muons with energies near 4.5 GeV incident at an angle of 45° with the zenith was found to be -0.34 ± 0.04. These polarizations are consistent with the polarizations calculated on the basis that the muons are derived almost wholly from the decay of pions produced by the interaction of primary and secondary cosmic-ray hadrons with the nuclei of the atmosphere. (Diss. Abstr. Int., B)

18008 DEPTH PROFILES OF GALACTIC COSMIC RAY PRODUCED RADIONUCLIDES IN LUNAR SAMPLES. Finkel, R. C. San Diego, CA; Univ. of California (1972). 162p. University Microfilms Order No. 73-33,082.

Thesis (Ph. D.).

The concentrations of several cosmogenic radionuclides as a function of depth were analyzed by radiochemical means in lunar samples from the Apollo missions. A chemical separation procedure, which relied heavily on ion exchange techniques, was used to separate the following elements from samples of lunar soil and rock: Be, Na, Al, Cl, V, Mn, Fe, Co, and Ni. This procedure and the subsequent radiochemical purification of these elements is described. Atomic absorption techniques for monitoring the separative procedure and for analyzing the lunar materials are discussed. (TSS)

18009 AIR SHOWER GROUP. Wiedecke, L.; Aschenbach, B.; Boehm, E. Atomkernenergie; 20: No. 3, 179-188(Dec 1972). (In German).

There are two small groups more or less closely connected with the core of the extensive air shower group, one of them working on theoretical problems (induced representation and field equations), the other conducting cloud chamber experiments (evidence

for muon bundles and search for quarks in extensive air showers). The core of the group is concerned with problems of transverse momenta in high-energy strong interactions and with the chemical composition of the cosmic radiation in the energy range above 10^{14} eV. The work done with the large Kiel air shower array and with the smaller one at the Pic du Midi is reported, as well as first results of a cooperation at the Pic with a group from Turin measuring the Cherenkov light emitted by air showers. The problems arising in the attempt at separating the information—thoroughly mixed up in air showers behind the maximum of their development—about the properties of the primaries and those of high-energy interactions are discussed. (auth)

18010 POSSIBLE COSMIC-RAY PRIMARY-PARTICLE ENERGY SPECTRUM ABOVE 10^4 GeV AND ITS ASTROPHYSICAL IMPLICATIONS. Subramanian, A. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A; 76: No. 3, 121-128(Sep 1972).

A primary cosmic-ray particle energy spectrum of galactic origin with a sharp cut-off at an energy per nucleon of 3×10^4 GeV for protons and 5×10^4 GeV for heavier particles and extending up to energies $\sim 10^{15}$ eV is deduced in part from the observed cosmic-ray phenomena at the highest energies. It appears that the cut-off is not due to the magnetic rigidity of the particles in the Galaxy but due to a cut-off in or near the sources themselves. In particular, it is pointed out that Fermi type of acceleration is unlikely to be important in the production of energetic cosmic-ray particles in the Galaxy. A pedestal in the energy spectrum from an extra galactic component up to a maximum energy per nucleon $\sim 10^7$ GeV with an upper limit of total energies $\sim 10^{18}$ eV has been added. (auth)

18011 MODULATION AND ENERGY SPECTRUM OF HIGHLY CHARGED COSMIC-RAY NUCLEI. Cleghorn, T. F.; Freier, P.; Waddington, C. J. (Univ. of Minnesota, Minneapolis). Astrophys. Space Sci.; 14: No. 2, 422-430(Dec 1971).

The intensity and energy spectrum of cosmic-ray VH-nuclei ($20 \leq Z \leq 30$) has been measured in a stack of nuclear emulsions exposed over Fort Churchill in 1968. The integral intensity above 300 MeV/N was 1.04 ± 0.04 nuclei $m^{-2}sr^{-1}s^{-1}$ and three differential intensities were measured below 750 MeV/N. Because of the current controversy regarding the true intensities of helium nuclei at this phase of the solar cycle these were also measured, obtaining results intermediate between those quoted by other workers. Comparison of these results on the VH- and helium nuclei with those obtained in previous observations made at times of low solar modulation leads to the conclusion that there is no significant charge dependence in the modulation process. This conclusion is in conflict with an earlier analysis but depends on results of improved statistical weight and greater reliability for the VH nuclei and on the measurement of the helium nuclei in the same detector. (auth)

18012 ENERGY SPECTRUM OF PRIMARY COSMIC-RAY ELECTRONS FROM 2 GeV TO 200 GeV. Fanselow, J. L.; Hartman, R. C.; Meyer, P.; Schmidt, P. J. (Univ. of Chicago). Astrophys. Space Sci.; 14: No. 2, 301-313(Dec 1971).

A balloon-borne counter telescope with a gas Cherenkov counter was used to measure the energy of primary cosmic-ray electrons between 2 and 200 GeV. Electrons were identified by the characteristic electron–photon shower which they produce in a 15 radiation length deep stack of high-Z material interleaved with scintillation counters. Calibrations with monoenergetic electrons up to 14 GeV and monoenergetic protons up to 28 GeV from accelerators were used to develop criteria to statistically separate electrons from proton induced events. The results from six balloon flights (total exposure time 63 hours) were combined to obtain the electron energy spectrum. Up to about 30 GeV the spectrum measured in this experiment could be directly checked with calibrations and agreed well with results from other experiments. Above this energy the flux was somewhat higher than the determinations reported by most other authors. Not much significance was attached to an apparent flattening of the energy spectrum above 50 GeV. There was no evidence for a steepening of the spectrum at energies below 200 GeV. (auth)

18013 POSSIBLE MECHANISM FOR THE INJECTION OF PARTICLES INTO A COSMIC-RAY ACCELERATION REGION. Kristiansson, K. (Lund Univ., Sweden). Astrophys. Space Sci.; 14: No. 2, 485-500(Dec 1971).

The composition of the nucleonic component of the primary cosmic radiation has been compared with the natural abundance of the elements. A normalized quotient between the abundance of an element in the radiation and in nature was found to be approximately equal to Z^{α}, where Z is the atomic number and α is a constant approximately equal to one. The observed excess of the heavy elements can be expected in the radiation if the selection of the cosmic-ray particles is performed by ionization through fast electron or proton impacts on neutral matter having "normal" composition. Such a selection mechanism may act in regions in space where fast moving thin plasma clouds collide with clouds of neutral matter. A source model in which the plasma clouds originate in Type II supernova explosions is discussed. (auth)

18014 VARIATIONS OF COSMIC-RAY INTENSITY IN CONSEQUENCE OF THE CO-ROTATION EFFECT. Somogyi, A. J. (Central Research Inst. of Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 261-74(1972).

It is shown that corotation of cosmic-ray particles with the drift velocity $v_d = \omega_s \times r$, where ω_s is the angular velocity of the rotation of the Sun, must also take place outside the solar equatorial plane wherever the general conditions for corotation are fulfilled. Predicted secondary effects of the corotation are: annual and semi-annual waves in the amplitude of the solar daily variation, a semi-annual wave in the phase of the solar daily variation, and an annual wave and north–south asymmetry in the total intensity of cosmic rays. The possibility of detecting these effects is discussed. (auth)

18015 CURRENT PROBLEMS OF HIGH-ENERGY COSMIC-RAY PRIMARIES. Wilson, J. G. (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 83-93(1972).

Problems of measurement of the total energy spectrum of primary cosmic-ray particles beyond 10^{17} eV are discussed, with the most recent conclusion that no significant change in the slope of the spectrum at higher energies has yet been established. The determination of the nature of particles of extreme energy presents much more difficult problems, and the relationship of studies of primary composition to details of shower development in the atmosphere as these are presented in model formulations is examined. (auth)

18016 ELECTRONS IN GALACTIC COSMIC RADIATION. Beuermann, K. P. Atomkernenergie; 20: No. 3, 192(Dec 1972). (In German).

Reviewed is the continuum cosmic radiation in the interplanetary space. At energies above 10 MeV, the radiation essentially is of galactic origin and comprises electrons as well as nuclei. The electron component claims special significance because its synchrotron radiation can be detected even in remote regions of the Galaxy. Near Earth, the cosmic radiation undergoes modulation through the solar wind. Electron measurements furnish not only information about structure of the interplanetary space beyond the terrestrial orbit but also about the nature of the radiation sources. (HBG)

18017 SECONDARY PHOTONS IN THE UPPER ATMOSPHERE. Scheel, J. Atomkernenergie; 20: No. 3, 242-244 (Dec 1972). (In German).

Developed were telescope counters that permitted the recording of both gamma and beta spectra in various angular directions at high altitude. Thus far, two balloon flights were conducted. During the total flight time of 18,600 sec., 30,000 gamma photons and 3,500 electrons were recorded. Results closed the previously existing information gap between 1.13 and 44 MeV in the secondary gamma spectrum. Moreover, causes and origin of the secondary gamma photons were elucidated and the anisotropy of their spectrum was explained. (HBG)

18018 KIEL EXPERIMENT FOR STUDYING COSMIC RADIATION ON BOARD THE SOLAR PROBE HELIOS. Kunow, H.; Green, G.; Mueller, R.; Witte, M.; Vollmers, H. Atomkernenergie; 20: No. 3, 193-194(Dec 1972). (In German).

The project HELIOS is a joint undertaking between NASA and the German Ministry for Education and Science. A space probe will be sent in the year 1974, and another one in 1975, in an elliptical orbit around the Sun. The closest point will be one quarter of the Earth distance, while the farthest will be twice the Earth distance from the Sun. Among the eight German experiments, one is designed by the University of Kiel and aims at the measurement of cosmic and solar radiation. As shown by a diagram, five semiconductor detectors are surrounded by a plastic anticoincidence scintillator, and to this arrangement is added a Cherenkov detector. Particles hitting the system are analyzed with respect to electric charge, mass, and energy. On-board data evaluation is performed by a computer system that is depicted in a block diagram. (HBG)

18019 ANOMALOUS BAROMETER COEFFICIENT OF COSMIC-RAY NEUTRON MONITOR AT Mt. NORIKURA. Kawasaki, S. (Inst. of Physical and Chemical Research, Wako, Japan).

Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 66: No. 2, 25-32(Jun 1972).

The value, −0.64%/mb, has been used for the barometer correction of the neutron intensity observed at Mt. Norikura. This value has long been pointed out as abnormally lower than that expected from the cut-off rigidity and the altitude of the station. In order to clarify this problem, the following points are studied: (1) the relation between the wind velocity and the pressure deviation at Mt. Norikura, (2) the barometer coefficients for groups classified by wind velocity, and (3) the frequency distribution of the daily mean values of wind velocity and their monthly variation throughout a year. It is confirmed by analyses that the value of barometer coefficient is affected remarkably by the hard wind at a mountain altitude, and the process of giving the lower value becomes clear. The coefficient, −0.70%/mb, is determined from the barometric pressure corrected by the formula: $\Delta P = 0.089v + 0.0019v^2$ where ΔP mb is the deviation of pressure due to the wind of velocity vm/sec. Some comments are given on the use of cosmic-ray data observed at stations where hard wind blows very frequently. (auth)

18020 POSSIBILITY OF REGISTERING PRIMARY COSMIC ELECTRONS BY MEANS OF SYNCHROTRON RADIATION IN THE GEOMAGNETIC FIELD. Prilutskii, O. F. (Moscow Engineering Physics Inst.) JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 320-321(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 452-454(20 Oct 1972).

The possibility of constructing a detector with linear dimensions on the order of 50 to 100 cm for simultaneous registration of an electron and two or three synchrotron-radiation photons is discussed. For electrons of energy above 100 GeV the counting rate should be 4.5 electrons/hour incident on 1 m^2 in a solid angle of 1 Sr. (WDM)

18021 POSSIBLE ORIGIN OF COSMIC γ RAY FLUX FROM PULSARS. Saha, S. K. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., A (London); 6: No. 1, 120-124 (Jan 1973).

The flux of celestial γ rays has been calculated from neutron stars (pulsars) on the basis of the model of neutron stars as developed by Tsuruta and Cameron and the cooling rate calculated by Raychaudhuri (J. Phys. A., Gen. Phys.; 4: 508 (1971)) taking into account neutrino emission according to the photon−neutrino coupling theory. The result is found to be in good agreement with the experimental results as obtained in OSO III experiments. (auth)

18022 ENERGY SPECTRA OF COSMIC PIONS AND NUCLEONS AT THE TOP OF THE ATMOSPHERE. Bhattacharyya, D. P. (Presidency Coll., Calcutta). Z. Phys.; 257: No. 4, 292-298(1972).

The production spectra of cosmic pions and their primaries were derived from the experimental muon spectrum by using the theories of Barrett, et al. and Feynman. The calculated pion production spectrum takes the form $I(E_\pi)dE_\pi = 0.206\ E_\pi^{-2.65}\ dE_\pi$ per cm^2 sec str GeV in the energy range $3 < E_\pi < 1500$ GeV, and the nucleon spectrum follows the relation $N(E_p)dE_p = 2.7 \times 10^4 (E_p/\text{GeV})^{-2.65}\ dE_p$ per m^2 sec str GeV in the range $5 < E_p < 3000$ GeV. (2 figures, 1 table) (auth)

Stars

Refer also to abstracts 18168, 18251, 18519, and 18548.

18023 IRON IN THE SUN AND STARS. Garstang, R. H. (Univ. of Colorado, Boulder). pp 338-94 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

Laboratory studies of iron spectra are briefly reviewed. Under the main heading of iron in the Sun consideration is given to the topics: ultraviolet solar line identifications; iron in the corona; solar iron abundance; and solar neutrino flux. Under iron in the stars is discussed: iron abundances in galactic star clusters; metals in globular cluster stars; interpretation of abundance results; iron in Magellanic cloud stars; iron in other galaxies; iron emission lines in peculiar stars; forbidden iron lines in RR Telescopic; and forbidden lines in Seyfert galaxies. (WDM)

18024 HELIUM SPECTRA IN LARGE MAGNETIC FIELDS. Garstang, R. H.; Kemic, S. B. (Univ. of Colorado, Boulder). pp 396-404 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The effects of a large (10^7 g) magnetic field on He I spectrum is as follows: the spectrum will consist of a blue shift superimposed on the usual Zeeman splitting. As one goes up a given series, the blue shift should increase as approximately n^4. At high fields it should also be possible to observe lines which are ordinarily forbidden due to inter-l mixing. Once again these lines should increase in strength as one goes up a series. The σ components of the forbidden lines should remain weaker than the π component, while just the opposite will be true in the case of the allowed lines. (WDM)

18025 SPECTROSCOPIC STUDIES OF NOVA DELPHINI 1967. Sanyal, A. Austin, TX; Univ. of Texas (1972). 247p. University Microfilms Order No. 73-510.

Thesis (Ph. D.).

Spectroscopic observations of Nova Delphini 1967 were made during the period July 1967−August 1969 with the coudé spectrographs of the 107 inch and 82 inch telescopes at the McDonald Observatory. The spectral range covered was λλ4000 to 9000 Å, with special emphasis on the region λλ6000 to 9000 Å in the nebular stage. The development of the spectrum through the nebular stage and its correlation with the light curve are discussed. The distance of the nova is estimated. (TSS) (Diss. Abstr. Int., B)

18026 OBSERVATIONS AND MODELS OF POLARIZATION IN LATE-TYPE STARS. Shawl, S. J. Austin, TX; Univ. of Texas (1972). 233p. University Microfilms Order No. 73-517.

Thesis (Ph. D.).

The nature of the particles that produce linearly polarized light from late-type giant and supergiant stars was studied with polarimetric, photometric, spectroscopic, and theoretical techniques. Observations are presented for 28 stars, with detailed discussions for o Cet, V CVn, X Her, g Her, VY CMa, L_2 Pup, IRC +10216, and R Hya. (TSS) (Diss. Abstr. Int., B)

18027 DYNAMIC STABILITY OF THE χ AND H PER ASSOCIATION. Mirzoyan, L. V.; Mnatsakanyan, M. A. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 6: No. 2, 175-177(1970).

Translated from Astrofizika; 6: No. 2, 337-340(1970).

In view of the definite interest in the conclusion reported by Kholopov (1968) that, in many cases, O-associations are ordinary, dynamically stable, young stellar clusters, the dynamic stability of such systems was investigated, including in particular the χ and h Per system. (WDM)

18028 VARIABILITY OF THE PERIODS OF LONG-PERIOD VARIABLES. Nudzhenko, A. G. (Odessa Astronomical Observatory). Astrophysics (Engl. Transl.); 6: No. 2, 141-144(1970).

Translated from Astrofizika; 6: No. 2, 277-285(1970).

The Sterne method was applied to 252 long-period variables with a view to establishing the presence of stars with variable periods. It was found that for 43 of these stars the period variability cannot be explained by statistical flunctuations alone. For all the stars the cumulative error was compared with the period. (auth)

18029 GENERATION OF THE STELLAR MAGNETIC FIELD BY PARTIALLY IONIZED CONVECTIVE ENVELOPES. I. Drobyshevskii, E. M. (Ioffe Inst. of Physics and Tech., Leningrad). Astrophysics (Engl. Transl.); 6: No. 2, 145-153(1970).

Translated from Astrofizika; 6: No. 2, 287-300(1970).

The generation of the magnetic field of rotating stars by partially ionized convective envelopes as a result of the appearance of the inertial emf during the Coriolis acceleration of convective currents is discussed. Assuming that momentum exchange between the convective elements occurs exclusively through the hydrodynamic interaction between them (it is shown that this will ensure the necessary magnitude of the Coriolis forces), a calculation is carried out of the magnetic field H_p at the poles of the Sun. The effect of the Coriolis forces on the parameters of partially ionized plasma in the convective elements is taken into account. It is found that $H_p \approx 5 \times 10^{-4}$ Oe, and this is much less than the figure of about 1 Oe which is currently accepted as the solar magnetic field in the near-polar regions. This discrepancy may indicate that the Coriolis forces are not of hydrodynamic origin, or that there is some mechanism which is responsible for the enhancement of the field. (auth)

18030 PULSATION PERIODS OF ROTATING WHITE DWARFS NEAR THE CHANDRASEKHAR LIMIT. Imshennik, V. S.; Seidov, Z. F. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 6: No. 2, 154-158(1970).

Translated from Astrofizika; 6: No. 2, 301-307(1970).

The energy method was used to calculate the periods of radial pulsations of cold, uniformly rotating white dwarfs near the Chandrasekhar limit. The minimum pulsation periods were determined. It is shown that solid-body rotation close to the pos-

sible limit leads to a reduction in the minimum pulsation period by a factor of more than three (from about 1.8 sec to about 0.5 sec). The Chandrasekhar equation of state is assumed, and general relativity corrections are introduced. (auth)

18031 GENERATION OF RELATIVISTIC PARTICLES BY NEUTRON STARS IN THE STATE OF ACCRETION. Shvartsman, V. F. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 6: No. 2, 159-163(1970).

Translated from Astrofizika; 6: No. 2, 309-317(1970).

Gas accretion on a neutron star should be accompanied by the injection into cosmic space of relativistic electrons and positrons in addition to the emission of x rays and gamma rays. These particles may form a component of cosmic rays and may be responsible for the radio emission of neutron stars. When the rate of accretion is high enough, the inverse Compton effect on x-ray photons scattered by the material incident on the star becomes important. The particle energy is converted into the energy of the gamma and hard x-ray radiation. This process does not, however, lead to a complete retardation and annihilation of the positrons, since there is a simultaneous and specifically electrostatic acceleration mechanism which maintains their relativistic energies. If the neutron star oscillates, then the generation of relativistic particles should also be subject to pulsations, and this may be responsible for the periodicity in the emitted radio signal. (auth)

18032 NUMERICAL EXPERIMENT ON A QUASISTATIONARY SPHERICAL SYSTEM WITH STARS OF DIFFERENT MASS. Baranov, A. S. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 2, 133-140(1970).

Translated from Astrofizika; 6: No. 2, 261-275(1970).

The validity of the ergodic theory in stellar dynamics is discussed. The possibility of a direct determination of time averages in systems of moderate multiplicity is noted. The results of a numerical experiment are used to construct a model of a quasistationary spherical system consisting of five bodies of different mass. The stellar density, the potential residual velocity dispersion in the radial and transverse directions, and certain other parameters are determined. (auth)

18033 SPECTROSCOPIC VARIABLE CU VIR AND THE INCLINED ROTATOR MODEL. Khokhlova, V. L.; Ryabchikova, T. A. (Astronomical Council, Moscow). Astrophysics (Engl. Transl.); 6: No. 2, 112-119(1970).

Translated from Astrofizika; 6: No. 2, 227-240(1970).

The variation of the line intensities and profiles in the spectrum of the Ap variable Cu Vir (HD 124224) was investigated. It was established that the intensity variation observed for the Si II and He I lines was not connected with a change in the excitation conditions. The difference between the line half-widths of different elements, and the variation in the radial velocities and equivalent widths, can be explained by the inclined rotator model put forward by Deutsch for magnetically and spectroscopically variable Ap stars. The angle between the line of sight and the rotational axis is 47°, and the angle between the rotational and magnetic axes is about 20°. It is suggested that the Si II lines are formed preferentially in regions located near the magnetic poles, whereas the He I lines originate mainly near the magnetic equator. The Si II regions appear to be more stable than the He I regions. (auth)

18034 POLARIZATION OF THE LIGHT FROM RED VARIABLE STARS OF HIGH LUMINOSITY. Dombrovskii, V. A. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 2, 100-111(1970).

Translated from Astrofizika; 6: No. 2, 207-225(1970).

A review is given of multicolor polarimetric observations of a number of high-luminosity red variables, which were performed during the last few years in the Astronomical Observatory of Leningrad State University. The radiation emitted by many of these stars exhibits intrinsic polarization which is variable in all cases. It has been found that the degree of polarization, and the range of the variations in it, increase with decreasing wavelength, but the position angle of the plane of polarization for most of the stars is, on the whole, independent of wavelength although its values at different instants of time are appreciably different in different colors. The time dependence of the degree of polarization is different for each star, and exhibits many irregularities. A correlation between variations in the polarization, luminosity, and color has been established for a number of stars. The behavior of the polarization parameters p, Θ, the luminosity V, and the B−V color index for V CVn, X Her, and Z UMa is shown. For a number of stars, the long-wave dependence of the polarization has been studied up to $\lambda \approx 2.5\,\mu$. Spectro-polarimetric studies have been carried out on AK Peg. Various hypotheses put forward to explain the intrinsic polarization of high-luminosity red variables are reviewed. It is found that the most probable mechanism is that in which the polarization is due to scattering in clouds of matter surrounding the stars. (auth)

18035 CHROMOSPHERES OF UV Cet STARS. Gershberg, R. E. (Crimean Astrophysical Observatory, Simferopal, USSR). Astrophysics (Engl. Transl.); 6: No. 2, 92-99(1970).

Translated from Astrofizika; 6: No. 2, 191-205(1970).

The results of a spectrophotometric study of five flare stars of the UV Cet type in the quiet state are reported. Measurements were made of the relative emission—line intensities, the absolute luminosities, and the profile of the H_α emission line. These data were compared with the corresponding characteristics of the solar chromosphere, taking partly into account the different observational conditions for the extended solar chromosphere and the point-like stellar chromosphere. This comparison shows that there is a considerable similarity between regions in the solar and stellar chromospheres which are responsible for the Balmer line emission, but the density in these regions in the case of the flare stars appears to be higher by factors of 10 to 100 as compared with the Sun. The properties of the lower chromospheres and the coronas of flare stars are briefly discussed. (auth)

18036 SPECTROSCOPIC AND PHOTOMETRIC OBSERVATIONS OF LUMINOUS STARS IN CARINA−CENTAURUS (l = 282 TO 305°). Humphreys, R. M. (Steward Observatory, Tucson, AR). Astron. Astrophys., Suppl. Ser.; 9: No. 1, 85-96(Jan 1973).

New observational data are presented for 176 luminous stars of all spectral types, and UBV photometry. (auth)

18037 SOUTHERN OPEN STAR CLUSTERS. II. UBV−Hβ Photometry of 11 Clusters Between Galactic Longitudes 259° and 280°. Vogt, N.; Moffat, A. F. J. (Ruhr-Univ., Bochum, Ger.). Astron, Astrophys., Suppl. Ser.; 9: No. 1, 97-131(Jan 1973).

Of the eleven clusters, four have spectral types younger than B3. Their distribution suggests the presence of a spiral feature at $l \sim 270°$ in agreement with recent observations of other types of spiral-arm tracers. Suspected supergiants of luminosity class II were found in two of the clusters. (auth)

18038 VARIATION OR DISAPPEARANCE OF THE EMISSION IN 8 Be STARS. Hubert, H. (Observatoire, Meudon, France). Astron. Astrophys., Suppl. Ser.; 9: No. 1, 133-148(Jan 1973). (In French).

Qualitative results are given on eight Be stars (HD 50658, HD 168797, HD 175863, HD 177648, HD 210129, HD 214168, HD 217543, and HD 212076) which present the same type of variation of the emission: cyclic disappearing or weakening of the emissive shell. For each star the emission variation period was determined; five of them had a period inferior to twenty years. It was found that all these stars presented some variations of absorption lines (H, HeI, MgII, NaI, and CaII). For the most of them, these lines are strengthened during the transition B−Be and Be−B phases. These characteristics show that it is very difficult to classify these stars with the typical tests used in spectroscopy. (auth)

18039 NOTE ON THE GRAVITATIONAL FIELD OF A ROTATING RADIATING SOURCE. Goodinson, P. A. (Queen Elizabeth Coll., London). J. Phys., A (London); 5: No. 12, L131(Dec 1972).

Kramer (1972) gave an exact axially-symmetric nonstationary solution of Einstein's field equations with the energy momentum tensor of a radiation field. In this note a generalization of the Kramer solution is given. (UK)

18040 LINE SPECTRA OF EIGHT O STARS FROM λ3059 TO λ6683. Scholz, M. (Univ., Heidelberg). Astron. Astrophys., Suppl. Ser.; 7: No. 4, 469-486(Dec 1972).

Measurements from high-dispersion photographic spectrograms of ζ Ori A (O 9.5 Ib), HD 188209 (O 9.5 III), HD 34078 (O 9.5 V), HD 57682 (O 9 V), λ Ori A (O 8), 15 Mon A (O 7), HD 54662 (O 6), and 9 Sgr (O 5) are presented. Identifications, equivalent widths, and profiles of absorption and emission lines in the wavelength range λ 3059 to λ 6683 are given. HD 188209 seems to be linked to Walborn's ON stars. (auth)

18041 DETERMINATION OF DISTANCE, ABSORPTION, PROBABLE PHYSICAL MEMBERS AND AGE FOR THE OPEN CLUSTERS HAFFNER 8, HAFFNER 6, BASEL 11, AND NGC 2374. Fenkart, R. P.; Buser, R.; Ritter, H.; (and others) (Univ., Basel). Astron. Astrophys., Suppl. Ser.; 7: No. 4, 487-496(Dec 1972).

Distance, absorption, probable physical members, and age of four open clusters were determined with the help of three-color photometric methods in the UBV system. The long-wave (V, B−V) and short-wave (V, U−B) color−magnitude diagrams yield the photometric data of the clusters Haffner 8, Haffner 6, Basel 11, and NGC 2374, respectively. No interstellar absorption was observed in this direction in the range of distances covered by

these clusters (1.13 to 1.67 kpc). None of these clusters can be considered as a spiral arm indicator since their earliest spectral-types are all later than b2. They yield "photometric" ages between 2.0 and $7.9 \cdot 10^8$ years. (auth)

18042 OLD OPEN CLUSTER NGC 6819. Lindoff, U. (Lund Observatory, Sweden). Astron. Astrophys., Suppl. Ser.; 7: No. 4, 497-513(Dec 1972).

An investigation of the old open cluster NGC 6819 was made on the UBV-system, using a combination of photographic and photoelectric photometry. The color excess, E_{B-V}, was determined to 0.3m and the distance to 2200 pc. The cluster contains about 60 giant members, the brightest of which is found to be variable. NGC 6819 is one of the oldest open clusters known. The age was estimated at 2.10^9 years. Comparisons were made with other old clusters. About 20 stars, situated in the surroundings of the cluster and with spectral classes around A0, were measured in order to get some information about the color excesses in front of the cluster. (auth)

18043 SURFACE GEOMETRY OF CHARGED ROTATING BLACK HOLES. Smarr, L. (Univ. of Texas, Austin). Phys. Rev., D; 7: No. 2, 289-295(15 Jan 1973).

Invariant measures of the surface geometry of a charged rotating (Kerr–Newman) black hole are examined. It is shown that as the rotation rate of the black hole increases, the equatorial circumference increases while the polar circumference decreases. This is analogous to effects in material rotating bodies. The number of parameters describing a charged Kerr black hole drops from three to two on its surface. It is found that a scale parameter η and a distortion parameter β describe this geometry very simply. There emerge two classes of Kerr matrices separated by $\beta = \frac{1}{2}$. For larger β the Gaussian curvature becomes negative on two polar-cap regions and the surface cannot be globally embedded in Euclidean 3-space. Possible physical effects are briefly discussed. (auth)

18044 CENTRAL SINGULARITY OF RELATIVISTIC FLUID SPHERE. Ganea, I. M. (Observatorul Astronomic, Bucharest). Stud. Cercet. Astron.; 17: No. 2, 267-273(1972). (In Rumanian).

The singularity is considered which appears in the Schwarzschild interior metrics when the radius of the sphere is $R = \frac{9}{8} R_s$, where R_s is the Schwarzschild radius. In this case the coefficient of dt^2 becomes zero in the center, and has the value $\frac{1}{9}$ to the surface; the central pressure becomes infinite. Using the analogy between the classical gravitational potential, and e^ν, the coefficient of dt^2, it is shown, for any real, compressible fluid, that the central singularity must appear for a value of $e^\nu > \frac{1}{9}$ at the surface, so that for the redshift of the light emitted at the surface of the sphere, the inequality $z < 2$ is always fulfilled. (auth)

18045 REMARKS ON THE PERIOD OF TW DRACONIS. Todoran, I. (Astronomical Observatory, Cluj). Stud. Cercet. Astron.; 17: No. 2, 203-211(1972).

The diagram of the O–C differences is examined. The following hypotheses are made concerning the cause of the variation of the orbital period: the presence of a third component, the apsidal motion, and the exchange of matter, but none of these may be accepted without reservation. (auth)

18046 NAPIER METHOD FOR THE PHOTOMETRIC REFLECTION EFFECT IN CLOSE BINARY STARS. Ureche, V. (Univ., Cluj). Stud. Cercet. Astron.; 17: No. 2, 213-220(1972).

Some modifications of Napier's method (1968) are considered in order to make it more easy for applications. Thus the incident flux at any point of the reflecting star, the effective temperature distribution on the reflecting star, and the monochromatic intensity of the reflected radiation are computed. The total monochromatic luminosity reflected by the binary system is given. Developments allow to compare the theory with the observations. An application to the close binary system AI Draconis is made. The results obtained with Napier's method and with Kopal's method are compared. The computed reflection coefficients are considerably larger than those obtained from observations. This fact indicates that the albedo is about 0.3 to 0.5, in agreement with Rucinski's results for the binary systems with Algol-type secondaries. For some values of the ratio T_1/T_2 ($T_1 > T_2$), the computed reflection coefficient may be negative. (auth)

18047 MASS-LUMINOSITY RELATION FOR WHITE-DWARF STARS. Osada, J.; Capelato, H. V.; Boniiha, J. R. M. (Univ., Sao Paulo, Brazil). Rev. Brasil. Fis.; 1: No. 1, 123-128(Apr 1971).

Improving the model of Milne in which the white-dwarf star is considered as consisting of an envelope of perfect gas and an internal part of degenerate electron gas, the relation between its mass and luminosity was investigated. In conclusion it was found that, though the masses are the same, the luminosity of the white dwarfs which contain light elements in their interior is greater than that of those which contain heavier elements. (auth)

18048 MAGNETIC STARS WITH AN EXTERNAL NONLINEAR FORCE-FREE FIELD. Raadu, M. A. (High Altitude Observatory, Boulder, CO). Astrophys. Space Sci.; 14: No. 2, 464-472 (Dec 1971).

The possible existence of strong magnetic fields in stars is discussed and a method of constructing highly distorted models of magnetic, rotating stars developed. For stars with both poloidal and toroidal fields at the surface a force-free outer boundary condition is necessary. Nonlinear solutions of the force-free equations must be used. The force-free equations and the structure equations for a white dwarf are solved simultaneously by a finite difference method. (auth)

18049 OBSERVATIONS OF THE PLANETARY NEBULA NGC 6853 AT [NII] 6584 Å. Danks, A. C. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 14: No. 2, 480-484(Dec 1971).

New observations of the [NII]6584 Å line were made over the surface of the Dumbell nebula (NGC 6853). The observed lines at the center of the nebula disc exhibited line splitting of $\simeq 54.3$ km s^{-1}. The lines appeared double at the center of the nebula and became single at the boundary. These observations are discussed and compared with those obtained by previous workers. (auth)

18050 ORDINARY URCA PROCESS IN THE PRESENCE OF POSITRONS AND LARGE MAGNETIC FIELDS. McFee, R. W. (Univ. of Nebraska, Lincoln). Astrophys. Space Sci.; 14: No. 2, 446-453(Dec 1971).

The effect of positron capture on the ordinary URCA neutrino luminosity in a zero magnetic field was investigated for several values of the degeneracy parameter and the range of temperatures 5×10^8 to 5×10^{10} K. The rate for this process was then compared with those in large magnetic fields (on the order of $H_c = m^2c^3/eh = 4.414 \times 10^{13}$ G). The results indicate that positron capture reduces the effect of large magnetic fields on this process at high temperatures. (auth)

18051 VARIATION OF THE GRADIENT AND BALMER DISCONTINUITY DURING THE ECLIPSE OF THE VARIABLE RW TAURI: COMPARISON BETWEEN OBSERVATIONS AND THEORY. Battistini, P. L. (Osservatorio Astronomico, Bologna); Fracassini, M.; Pasinetti, L. E. Astrophys. Space Sci.; 14: No. 2, 438-445(Dec 1971).

For the first time after Barbier and Chalonge's (1938, 1941) pioneering works, the variations of φ_b and D during the eclipse of RW Tau were observed. The observations were performed at the Observatories of Jungfraujoch and Haute Provence with the photoelectric system in seven colors of Geneva (Golay, 1964; Hauck, 1968). The comparison between the observed curves of D and the theoretical ones provided the limb darkening coefficients; the same comparison between the observed φ_b (reddened) and theoretical ones (not reddened) together with that of D indicated some anomalies of the variable RE Tau. (auth)

18052 EVOLUTION OF HYDROGEN–HELIUM STARS. Ezer, D. (Goddard Inst. for Space Studies, New York); Cameron, A. G. W. Astrophys. Space Sci.; 14: No. 2, 399-421(Dec 1971).

According to the work of Truran and Cameron, and of others, on the chemical evolution of the Galaxy, the first generation of stars in the Galaxy contained principally massive objects. If big-bang nucleosynthesis was responsible for the formation of helium, the first generation of stars would contain about 80% hydrogen and 20% helium, to be consistent with the approximately 22% helium found in recent stellar evolutionary studies of the Sun. The present investigation has followed the pre-main-sequence evolution and the main-sequence evolution of stars of 5, 10, 20, 30, 100, and 200 $M_\odot$. Normal stars in this entire mass range normally convert hydrogen into helium by the CN-cycle on the main sequence. The present hydrogen-helium stars of 5 and 10 $M_\odot$ must reach higher central temperatures in order to convert hydrogen to helium by the proton–proton chains. Consequently, the mean densities in the stars are greater, and the surface temperatures are higher than in normal stars. In the stars of 20 $M_\odot$ and larger, the proton–proton chains do not succeed in supplying the necessary luminosity of the stars by the time the contraction has produced a central temperature near 10^8 K. At that point triple-alpha reactions generate small amounts of ^{12}C, which then acts as a catalyst in the CN-cycle, the rate of which is then limited by the beta-decays occurring within the cycle. During the evolution of these more massive stars, the central temperature remains in the vicinity of 10^8 K, and the surface temperature on the main sequence approaches 10^5 K. The star of 200 $M_\odot$ becomes unstable against surface mass loss through radiation pressure in the later stages of its main-

sequence evolution, and these mass loss effects were not followed. Young galaxies containing these massive stars will have a very high luminosity, but if they have formed at one-tenth the present age of the Universe or later, then the light from them will mainly reside in the visible or ultraviolet, rather than in the infrared as has been suggested by Partridge and Peebles. (auth)

18053 EXPLOSIVE CARBON-BURNING NUCLEOSYNTHESIS. Hansen, C. J. (Univ. of Colorado, Boulder). Astrophys. Space Sci.; 14: No. 2, 389-395(Dec 1971).

Results are presented which show the final abundances of the major nuclei produced in explosive, but partial, carbon-burning taking place in a rapidly expanding medium. The effects of energy deposition due to burning and expansive cooling are taken into account explicitly. The results are compatible with those obtained by other authors but show the sensitivity of the final abundances to the assumed initial conditions. A conjecture is made as to the physical site of the burning. (auth)

18054 RELATIVISTIC EVOLUTION OF 10^3 SOLAR MASS STAR. Kovetz, A. (Univ. of Montreal); Shaviv, G. Astrophys. Space Sci.; 14: No. 2, 378-388(Dec 1971).

A fully relativistic evolution of 10^3 $M_\odot$ is described for initial composition of Y = Z = 0. The results show that (a) a great part of the star is in radiative equilibrium, (b) the maximal redshift for main-sequence 10^3 $M_\odot$ stars is significantly less than for isentropic models, and (c) a very low amount of CNO elements ($< 10^{-8}$ by mass) is formed at any stage before hydrogen is completely consumed and hence such stars cannot be the progenitors of Population II stars. (auth)

18055 DEPENDENCE OF Q METALLICITY INDEX FROM BASIC PARAMETERS OF STELLAR EVOLUTION. D'Antona, F. A. (CNR, Frascati, Italy). Astrophys. Space Sci.; 14: No. 2, 314-316(Dec 1971).

The possible dependence of Van den Bergh's Q parameter on the mass distribution function in globular clusters is investigated. The resulting independence within the observational errors assures that Q is available as index of the chemical composition and age of the clusters. (auth)

18056 RADIO EMISSION OF GALACTIC CLUSTERS AT 1.4 GHz AND 2.7 GHz. Schwartz, R. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Space Sci.; 14: No. 2, 286-300(Dec 1971).

41 galactic clusters containing stars with spectral types from O5 to B9 were observed at frequencies of 1.4 and 2.7 GHz. Only clusters with spectral types earlier than B1 showed thermal radio emission. Emission measure, mean electron density, and mass of H II gas were computed from the observed data, and a comparison between the radio flux and Hα- and Hβ-flux densities was made. The ratio of hydrogen mass and total stellar mass of the clusters and the gas to dust ratio are given. (auth)

18057 SUPERNOVA EXPLOSIONS. Apagyi, Barnabas. Fiz. Szemle; 22: No. 10, 295-301(Oct 1972). (In Hungarian).

The phenomena related to the "death of a star" are examined. The star uses all its energies to achieve its own explosion, thus helping to create new stars. Energy is released in the form of visible light during the explosion of the supernovae. The observational bases of the theoretical treatment of the problem are presented, considering specifically pulsars and nebulae. Going backward from the optical observations, it is possible to arrive at the pre-supernova state. The current theories are based on 3 models: 1. The Fe stars which result from an evolution yielding a stellar nucleus consisting of stable Fe nuclei and electron; 2. Neutrino stars in the carbon or oxygen-burning stage, radiating most of their luminosity in the form of neutrinos, and 3. double-shell red giants. The important role played by neutrinos in supernova explosions is outlined in the appendix. (TTT)

18058 OUTBURSTS OF CATACLYSMIC VARIABLES. Warner, B. (Univ. of Cape Town). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 35P-36P(1972).

It is proposed that outbursts of classical, recurrent, and dwarf novae originate in rotating white-dwarf stars. The consequent excitation of nonradial oscillations leads to a satisfactory understanding of the nonspherical ejection of nova shells. (auth)

18059 SPECTROSCOPIC ORBIT OF HD 90707. Evans, T. L. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 15-21(1973).

HD 90707 (B1 III) is an eclipsing binary and a probable member of the open cluster IC 2581 in Carina. The spectroscopic orbit has been determined from 29 observations of the radial velocity of the primary. Weak lines arising in the secondary yield m_2/m_1 = 1.09, a value which suggests that mass transfer has occurred. The brighter star nearly fills its Roche lobe. The light curve has nearly equal minima and shows variations between eclipses. The assumption that sin i = 1 leads to masses of 18.7 and 20.4 $M_\odot$ for the two components, larger than expected from an earlier comparison of the color–magnitude diagram with theoretical evolutionary tracks. The uncertainty introduced by the reflection effect on the determination of the velocity amplitude and hence the mass function may vitiate this conclusion. (auth)

18060 SPECTRUM OF THE BEAT CEPHEID U TrA. Rodgers, A. W.; Gingold, R. A. (Australian National Univ., Canberra). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 23-26 (1973).

A spectroscopic estimate of the surface gravity of U TrA is obtained which shows that this amplitude modulated variable has a similar gravity to Cepheids of the same period. (auth)

18061 NUMERICAL COMPUTATION OF THE DYNAMICAL EVOLUTION OF A SUPERNOVA REMNANT. Rosenberg, I.; Scheuer, P. A. G. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 27-45(1973).

This paper presents a numerical computation of the dynamical development of a simple model of a supernova remnant in which an expanding shell of ejected matter interacts with the interstellar gas. The evolution is followed continuously through the stages approximating to an undecelerated expansion, adiabatic blast wave, and the stage dominated by radiative cooling. (auth)

18062 NUMERICAL MODEL OF THE STRUCTURE AND EVOLUTION OF YOUNG SUPERNOVA REMNANTS. Gull, S. F. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 47-69(1973).

The evolution of the structure and radio emission of a young supernova remnant is discussed in terms of a fluid dynamic model of a supernova explosion. The interaction between the interstellar medium and the ejected material leads to a convective instability, which makes sufficient turbulent energy available to account for the observed synchrotron radio emission. From a study of different models of the ejected material it is found that the energy in the convection zone and the eventual radio source structure are insensitive to the initial conditions imposed on the explosion. The predicted radio emission rises to a maximum when the mass of interstellar material "swept up" is of the same order as the ejected mass, and then decays due to adiabatic expansion of the convection zone. (auth)

18063 TYPE I SUPERNOVAE. Branch, D.; Patchett, B. (Royal Greenwich Observatory, Herstmonceux Castle, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 71-83(1973).

Wavelength coincidences and comparison of observed and synthetic spectra support the hypothesis that Type I supernova spectra contain blueshifted absorption features (Fe II, Ca II, Na I, Si II, Mg II) characteristic of spectra of novae near maximum light. On the assumptions that the light curve is due to thermal emission from an expanding, optically thick photosphere and that the temperature may be derived from the normal stellar color–temperature relation, a modified Baade method is applied to a composite Type I light curve. The mean absolute visual magnitude at maximum light is found to be $20.8^{+0.9}_{-0.7}$ m. Combined with the observed apparent magnitude–redshift relation for Type I supernovae, this absolute magnitude leads to an estimate of the Hubble constant, $H_0 = 40^{+15}_{-13}$ km s^{-1} Mpc^{-1}. (auth)

18064 INFRA-RED OBSERVATIONS OF YOUNG STARS. 1. STARS IN YOUNG CLUSTERS. Cohen, M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 85-95(1973).

Narrow-band infrared observations in the 2 to 20 μ region are presented for a selection of stars in the young clusters NGC 2264, IC 5146, and the VI Cygni association. Additionally, infrared data are given for stars in the grouping of emission-Hα stars associated with NGC 7000, including the peculiar star Lk Hα-190 = V 1057 Cyg. (auth)

18065 INFRARED OBSERVATIONS OF YOUNG STARS. 2. T TAURI STARS AND THE ORION POPULATION. Cohen, M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 97-104(1973).

Multifilter infrared observations in the 2 to 22 μ region are presented for a number of T Tauri variables and early-type stars of the Orion population. The energy distributions of these stars are often characterized by a remarkable flatness. Infrared and visual variations of T Tauri itself appear to be anticorrelated. (auth)

18066 GRAIN ESCAPE VELOCITIES FROM COOL STARS. Gilman, R. C. (Univ. of Minnesota, Minneapolis). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 3P-4P(1973).

Wickramasinghe (Mon. Not. R. Astr. Soc.; 159: 269 (1972)) obtained grain escape velocities ~1000 km s^{-1} assuming that the drag of the circumstellar gas was negligible. It is shown that the drag of the circumstellar gas is not negligible, and when it is included, the escape velocities are more likely <100 km s^{-1}. (auth)

18067 INFRARED OBSERVATIONS OF YOUNG STARS. 3. NEBULOUS EMISSION-LINE STARS. Cohen, M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 105-111(1973).

Multifilter infrared observations of early-type nebulous stars are presented in the 2 to 22 μ region. Emission features in the 10 μ region are found in the stars AB Aur and V 380 Ori. It is found that stars associated with cometary nebulae are characterized by large [11] – [18] indices and this is discussed in the context of a possible picture of these nebulae. (auth)

18068 EDDINGTON FACTOR FOR RADIATIVE TRANSFER IN SPHERICAL GEOMETRY. Wilson, S. J.; Tung, C. T.; Sen, K. K. (Univ., Singapore). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 349-353(1972).

The present paper shows that, contrary to the statement of Hummer & Rybicki (Mon. Not. Astr. Soc.; 152: 1 (1971)) the half-range method (Wilson & Sen) (Ann. Astrophys.; 28: 348 (1965)) can handle the outward peaking effect of the radiation field in extensive spherical media. The source function J(r) and the Eddington factor f(r) = [K(r)/J(r)] have been calculated by the half-range method with $k(r) = r^{-2}$ for $0 < r \leq R$, where R = 3 and R = 10. The values for R = 10 are compared with those of Hummer & Rybicki and are found to be in fairly good agreement. (auth)

18069 STELLAR EVOLUTION TOWARD PRE-SUPERNOVA STAGE. II. CARBON AND OXYGEN STARS OF 1.5 AND 2.6 SOLAR MASS. Ikeuchi, S. (Kyoto Univ.); Nakazawa, K.; Murai, T.; Hoshi, R.; Hayashi, C. Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1870-1884(Dec 1972).

As a continuation of the preceding paper, the evolution of carbon-oxygen stars of $1.5M_\odot$ and $2.6M_\odot$ was computed from a pre-carbon-burning stage to a pre-supernova stage for the two alternative cases, with and without neutrino loss. In the case without neutrinos, it was found that after the termination of central carbon-burning electrons become degenerate at the center and both neon burning and silicon burning begin as strong flashes. Finally, both of the stars become dynamically unstable on account of the photo-disintegration of iron. In the case with neutrinos, the inversion of temperature gradient occurs in stages after central carbon burning. This is due to the effect of neutrino loss coupled with the effect of electron degeneracy. Finally, the $1.5M_\odot$ star and the $2.6M_\odot$ star become unstable on account of the inverse-beta process of silicon and the photo-disintegration of iron, respectively. (auth)

18070 PHOTOMETRIC SYSTEMS FOR QUANTITATIVE STUDIES OF WHITE DWARFS. Wickramasinghe, D. T.; Strittmatter, P. A. (Univ. of Arizona, Tucson). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 421-434(1972).

The suitability of the Strömgren uvby system for quantitative studies of white dwarfs is examined. For the cooler DA's the system yields useful indicators of the atmospheric parameters but is inadequate for gravity determinations for $T_{eff} \gtrsim 15{,}000$ K. An alternative intermediate band system is suggested which allows determinations of T_{eff} and g over the observed color range. The hydrogen deficient DB white dwarfs are also discussed. The uvby system is found to be unsuitable for quantitative studies of these stars and alternative methods are suggested. Masses and radii of cool DW white dwarfs for which reliable absolute magnitudes are available are derived from Graham's uvby photometry (Astr. J.; 77: 144 (1972)). No significant discrepancy with theoretical mass–radius relations for heavy-element interior compositions (He → Fe) is found. The scatter due to probable errors in the observational data, in particular the absolute magnitude determinations, is, however, very large. (auth)

18071 RADII OF WHITE DWARF STARS. Warner, B. (Univ. of Cape Town). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 435-440(1972).

From a calibration of the surface brightness in the V band as a function of (b – y) color in the Strömgren system, radii of white dwarfs with known distances are derived. It is shown that all the stars with first-class distances have radii in the range $8.92 \leq \log R(cm) \leq 9.12$. With a theoretical mass–radius relationship, this implies white dwarf masses in the range $0.21 \leq M \leq 0.65\ M_\odot$. There is good agreement between the location of white dwarfs in the Mv versus (b – y) diagram and cooling curves for stars of constant radius. (auth)

18072 HIGH-VELOCITY GAS NEAR THE GUM NEBULA. Thackeray, A. D.; Warren, P. R. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 23P-25P(1972).

Radcliffe coudé spectra of HR 3462 and 3527 confirm Wallerstein and Silk's observation (Astrophys. J.; 170: 289 (1971)) of high velocity Ca II components but show three additional components which complicate the interpretation. (auth)

18073 HIGH-RESOLUTION RADIO OBSERVATIONS OF AP LIB. Conway, R. G.; Stannard, D. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 31P-33P(1972).

Observations of PKS 1514-24 suggest a radio structure consisting of a compact component coincident with AP Lib, and an extended companion some 20″ arc away. The latter accounts for the displacement of the radio centroid from the optical position of AP Lib. (auth)

18074 NEUTRINO ENERGY LOSS IN NEUTRON STAR MATTER. Itoh, N.; Tsuneto, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6A 1849-1859(Dec 1972).

The theory of the energy loss due to neutrino processes in neutron stars is formulated in such a form that one can include the effect of strong interaction systematically. As an application the rates of energy loss are calculated for the following cases of interest in the study of neutron stars; i) the neutron and the proton liquid are both normal, ii) the proton or iii) the neutron liquid is in the superfluid state. The results largely confirm the earlier calculations by Bahcall and Wolf and by Wolf. The rate of energy loss in the state of nuclei coexisting with free neutrons is also discussed. (auth)

18075 INSTABILITY OF SHOCK WAVES IN INHOMOGENEOUS GASES. Yamazaki, H. (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1860-1869(Dec 1972).

The instability of an ideal-gas shock which propagates along the direction of density decrease, with respect to deformations of the shape of the shock front, was studied. A linearized ordinary differential equation which governs the disturbance was derived from an equation which gives the variation in shock strength through the density decrease of the gas and the divergence of the shock ray. Solutions of the equation were obtained in the case of plane shocks. The growth of deformation of a spherical shock-front propagating from the center of a star to the surface is discussed by using the solutions. It is shown that the shock can reach very near the surface before the shock front undergoes so remarkable a deformation as to break up to small parts. (auth)

18076 NUCLEOSYNTHESIS BY CHARGED-PARTICLE REACTIONS. Barnes, C. A. (California Inst. of Tech., Pasadena). Advan. Nucl. Phys.; 4: 133-204(1971).

Topics discussed include nuclear and elemental abundances, possible sites for nucleosynthesis, nucleosynthetic processes, charged-particle reaction rates, hydrogen burning, helium burning, synthesis of $20 \lesssim A \lesssim 60$ nuclei, synthesis of $A \gtrsim 60$ nuclei and the l-process, and nucleosynthesis in massive exploding objects. (WDM)

18077 NUCLEOSYNTHESIS AND NEUTRON-CAPTURE CROSS SECTIONS. Allen, B. J.; Gibbons, J. H.; Macklin, R. L. (Oak Ridge National Lab., TN). Advan. Nucl. Phys.; 4: 205-59 (1971).

The role of neutron capture reactions in the nucleosynthesis of heavy elements in stars is reviewed. Maxwellian-averaged capture cross sections at 30 keV are presented for most isotopes across the periodic table. Unmeasured cross sections are obtained by interpolations based on the systematic variation of cross sections with neutron number for odd- and even-Z nuclides. The empirical correlation of capture cross sections and s-process abundances is shown, and a consistent set of r-process abundances derived. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 18021, 18039, and 18073.

18078 (N-72-29831) STUDY OF OPTICAL PROPERTIES OF X RAY SOURCES. Final Report. Vanden Bout, P. A. (Texas Univ., Austin). 30 Jun 1972. 19p. (NASA CR-127771). NTIS.

A series of optical and x-ray observations of Sco X-1 and

Cyg X-2 by Uhuru satellite is reported. Results for Sco X-1 show a definite correlation between optical and x-ray intensity and thus indicate a common emitting region with the source being quiet and having no short-term fluctuations bigger than 10%. Spectra reveal the presence of a high excitation complex at wavelength 4650 due to N III–C III. Spectra of a faint 15-mag red object NW of the radio position indicate that Cyg X-1 is associated with a bright B supergiant star. The flux from the edges of the Cygnus Loop in the coronal line at wavelength 5303 was measured to be less than 5×10^{-3} erg/sq cm/sterad/sec (0.017 R) in a 3-A band centered on the line. This indicates substantial broadening of the line profile by mass motion or that the temperature is somewhat higher than the present estimate from x-ray data. (STAR)

18079 STUDY OF 2 TO 20 keV X RAYS FROM THE CYGNUS REGION. Bleach, R. D. College Park, MA; Univ. of Maryland (1972). 133p. University Microfilms Order No. 72-28,905.

Thesis (Ph. D.).

Two rocket-borne proportional counters each with 650 cm^2 net area and 1.8 × 7.1° FWHM rectangular mechanical collimation surveyed the Cygnus region in the 2 to 20 keV energy range on two separate occasions. X-ray spectral data gathered on September 21, 1970 from discrete sources in Cygnus are presented. The data from Cyg X-1, Cyg X-2, and Cyg X-3 have sufficient statistical significance to clearly indicate mutually exclusive spectral forms for the three. Upper limits are presented for x-ray intensities above 2 keV for Cyg X-4 and Cyg X-5 (Cygnus Loop). A search was made on August 9, 1971 for a diffuse component of x rays >1.5 keV associated with an interarm region of the Galaxy at galactic longitudes in the vicinity of 60°. A statistically significant excess associated with a narrow disk component was detected. The angular extent of this component has a most probable value of 2° and may be as large as 7° at 90% confidence. The best fit spectrum yields an intensity of 2.9 photons $(cm^2\text{-sec-ster})^{-1}$ over the 2 to 10 keV range. The 3σ upper limit to any emission (e.g., iron line) in a 1.5-keV band centered at 7 keV from galactic latitudes $|b| \leq 3.5°$ is .3 photons $(cm^2\text{-sec-ster})^{-1}$. Several possible emission models are discussed, with the most likely candidate being a population of unresolvable low-luminosity discrete sources. (Diss. Abstr. Int., B)

18080 THEORETICAL STUDIES OF ATOMIC AND GAS DYNAMICAL PROCESSES IN ASTROPHYSICAL PLASMAS. Daltabuit, E. Madison, WI; Univ. of Wisconsin (1972). 108p. University Microfilms Order No. 72-23,308.

Thesis (Ph. D.).

This thesis is formed by several sections. In these sections: (a) A compilation of atomic data necessary to compute collisional ionization rates, radiative recombination rates, and permitted, forbidden, and semiforbidden line emission rates in a gas is presented. Approximate values for the threshold energies, threshold cross sections, and the energy dependence of the cross sections for K-shell photoionization are tabulated for all ions of astrophysical interest. (b) Results are given from a calculation of the permitted, forbidden, and semiforbidden cooling coefficients for a collisionally ionized plasma at equilibrium for temperatures from 10^3 to 10^8°K. (c) Collisional excitation is shown to make small but nonnegligible contributions to lower members of the ($n\,^3D - 2\,^3P$) series lines in neutral helium. It is shown that this, combined with recent capture-cascade calculations for the helium singlets, implies a reduction in nebular helium abundance. It is also shown that theory and observations of helium triplet line intensities agree within the respective uncertainties. (d) It is proposed that the primary source of energy for quasi-stellar objects is the conversion of the kinetic energy of two colliding clouds into radiation in a pair of shock fronts at the interface. The spectrum of this energy source is computed. (Diss. Abstr. Int., B)

18081 LOW-LATITUDE GALACTIC SURVEY FROM l^{II} = 46° TO 61° AND 190° TO 290° AT 2700 MHz. Day, G. A.; Caswell, J. L.; Cooke, D. J. (CSIRO, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 25, 1-19(Dec 1972).

The results of observations of the galactic plane in the longitude ranges 46 to 61° and 190 to 290° undertaken with the 64 m (210 ft) radio telescope of the Parkes Observatory are given in the form of contour maps and a list of 343 radio sources. At the observing frequency of 2700 MHz the half-power beamwidth was 8.2′ arc. Some individual sources are discussed in detail. The present results together with those already published complete the Parkes 11 cm survey of the galactic plane. (auth)

18082 PARKES 2700 MHz SURVEY. Part IV. Catalog for the South Polar Cap Zone, Declinations –75° to –90°. Shimmins, A. J.; Bolton, J. G. (CSIRO, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 26, 1-25(Dec 1972).

This paper presents a catalogue of 454 extragalactic radio sources obtained from a sky survey at 2700 MHz. The area of 0.214 sr covers the south polar cap from declination –75° to –90°. The catalogue is complete to a limiting flux density of 0.26 f.u. (640 sources per steradian) at 2700 MHz and is thought to be at least 90% complete at a flux density of 0.15 f.u. (approximately 1400 sources per steradian). The positions are accurate to 16″ arc in both coordinates for sources of 0.26 f.u. and to 13″ arc for the stronger sources; the flux densities are accurate to 0.02 f.u. for the weaker sources and to 3% of the flux density for the stronger sources. (auth)

18083 RADIAL VELOCITIES FROM THE RADIO RECOMBINATION LINES OF ORION A. Batchelor, A. S. J.; Brocklehurst, M. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 27P-30P(1972).

The increase in the values of the radial velocities of Orion A radio recombination lines with n may be explained in terms of masing and a radial expansion of the nebula. (auth)

18084 STRUCTURE OF THE CRAB NEBULA. 2. THE SPATIAL DISTRIBUTION OF THE RELATIVISTIC ELECTRONS. Wilson, A. S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 355-371(1972).

A diffusion-loss model is proposed for the Crab Nebula. Relativistic electrons are produced near the center of the nebula, diffuse outwards and lose energy by synchrotron radiation. Many of the observed features of the continuum emission may be explained in this way. (auth)

18085 STRUCTURE OF THE CRAB NEBULA. 3. THE RADIO FILAMENTARY RADIATION. Wilson, A. S. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 373-379(1972).

It is proposed that the 5 GHz continuum radiation from the optical filaments in the Crab Nebula is synchrotron radiation from an increased magnetic field. The field is circular (or spiral) about the filaments in agreement with Woltjer's suggestion (Bull. Astr. Inst. Netherl.; 14: 39 (1958)) that the filaments carry a current along their length. The radio prominence of filaments extended along the line of sight is a consequence of path length and effects of directional emission. The absence of enhanced optical continuum radiation from the filaments is attributable to the short half lives of the appropriate electrons against synchrotron losses. It is suggested that the circular field may originate from an interaction between the magnetic field of the pulsar and the ejected gas. (auth)

18086 DISTRIBUTION OF OPTICAL SPECTRAL INDICES FOR QSOs FROM U, B, V DATA. Evans, A. (University Coll. of Wales, Aberystwyth, Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 407-420(1972).

A term is derived to correct the U, B, V measurements for the quasi-stellar objects for the presence of emission lines. The corrected colors for 102 objects are calculated using different values of emission line equivalent widths. From the corrected colors, the spectral indices for the optical continua are obtained, assuming that the continua may be represented by a power-law function $F(\nu) \propto \nu^{-n}$. The spectral indices so derived are compared with those calculated from scanner measurements, and the color spectral indices that give the best agreement with the available scanner spectral indices are used to find the distribution of optical spectral indices for quasi-stellar objects. The mean spectral index for the sample is 1.02 with standard deviation 0.37. No significant difference is found between the spectral indices of "radio-quiet" objects and those that are strong emitters at radio frequencies. (auth)

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Refer also to abstracts 18023 and 18197.

18087 (AD-740884) FINAL TECHNICAL REPORT. Pecker, J.C.; Pottasch, S.R.; Rountree-Lesh, J.; Folkart, B. (Observatoire de Paris-Meudon (France)). 1972. 8p. NTIS.

The authors have proceeded to a more detailed analysis of the solar spectra in order to examine the characteristics of certain lines as a function of time. The plates, as well as the corresponding calibration data, have been converted by means of the microphotometer so as to give a geometrical representation of the relative brightness of any given part of the spectrum. Having reduced the spectra to the form intensity vs wavelength, the authors have proceeded to the analysis of individual line profiles, which are determined as a function, in wavelength, of the line intensity related to the continuum intensity. (auth)

18088 (N-72-30785) MECHANICAL-WAVE DISSIPATION IN THE LOWER CORONA: EMPIRICAL REQUIREMENTS FOR QUIET REGIONS. Moore, R. L. (Stanford Univ., Calif). Jun 1972. 10p. (NASA-CR-127345; SU-IPR-476). NTIS.

The relation between dissipation and temperature structure in the lower corona was empirically determined. This relation was then used in conjunction with the observed structure to estimate the damping length for mechanical waves. (auth)

18089 (N-72-30787) ACCELERATION OF HIGH-ENERGY PARTICLES IN SOLAR FLARES. Sakurai, K. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug 1972. 19p. (NASA-TM-X-65992). NTIS.

The relationship is discussed between some characteristics of microwave Type 4 radio bursts and solar cosmic-ray protons of MeV energy. It is shown that the peak flux intensity of those bursts is almost linearly correlated with MeV proton peak flux observed by satellites near the Earth and that protons and electrons would be accelerated simultaneously by a similar mechanism during the explosive phase of solar flares. Brief discussion is given on the propagation of solar cosmic rays in the solar envelope after ejection from the flare regions. (auth)

18090 FLARES, MAGNETIC CONFIGURATIONS, AND MAGNETIC ENERGY RELEASE. Janssens, T. J. (Aerospace Corp., El Segundo, CA). Solar Phys.; 27: No. 1, 149-163(Nov 1972).

Using a newly developed Aerospace digital videomagnetograph, three solar active regions were studied as to their magnetic configurations and their flare productivity. These three regions had very different types of magnetic configurations and different types of flare productivity. Previous theoretical and experimental research on flares and magnetic energy storage are reviewed, and various ways to observe magnetic energy release due to flares are discussed. Results for six subflares are presented. Five showed no measurable magnetic energy change and one result was questionable. Three counterexamples to Zirin's (1972) contention that as a rule Hα plage brightness is proportional to magnetic field strength are shown. Each of these three cases involved two plage regions of the same polarity and equal field strengths with one of the plages adjacent to a neutral line. In all three cases the plage region nearer the neutral line was much brighter. (auth)

18091 THREADLIKE CORONAL STREAMERS. Waldmeier, M. (Swiss Federal Observatory, Zurich). Solar Phys.; 27: No. 1, 143-148(Nov 1972).

Threadlike streamers have small cross sections that are almost constant over their whole length. A typical value of their diameter is 30,000 km. Threadlike streamers may reach a length of several hundred thousand kilometers or even more than a solar radius. A photometric analysis of a threadlike streamer, observed at the eclipse of July 20, 1963, yields an electron density 8 times larger than that of the undisturbed corona. This ratio undergoes only small variations with the distance from the Sun. (auth)

18092 CENTIMETER RADIATION ASSOCIATED WITH THE SOLAR LIMB PROMINENCE OF FEBRUARY 8, 1972. Bell, M. B. (National Research Council of Canada, Ottawa). Solar Phys.; 27: No. 1, 137-142(Nov 1972).

Detailed maps of the Sun were made on February 8 and 9, 1972 with a 2.2′ pencil beam. Superimposed upon a disc that shows only slight limb brightening, there were a number of radio emissive regions associated with centers of activity. Relatively intense radiation from the position of a limb prominence was apparent on February 8 but was absent on the 9th. Between observations the prominence became active leading to the ejection of a cloud of plasma. When the emission from the prominence at 2.2 cm was combined with observations at 10.7 cm, the spectral index obtained was much flatter than that usually associated with a center of activity. (auth)

18093 THERMAL AND NONTHERMAL SOFT X-RAY BURSTS. Landini, M.; Monsignori Fossi, B. C.; Pallavicini, R. (Osservatorio Astrofisico di Arcetri, Florence). Solar Phys.; 27: No. 1, 164-173(Nov 1972).

X-ray bursts observed for energies lower than 25 keV are usually interpreted as being produced by a thermal plasma with several million degrees of temperature. A small number of events recorded at Arcetri by real time telemetry of SOLRAD 9 satellite agrees with a thermal interpretation and gives temperatures ranging between 10×10^6 and 30×10^6K and emission measures, $\int N_e^2 dV$, between 10^{47} and 10^{48} cm^{-3}. An impulsive event recorded on January 7, 1969 shows an anomalous behavior. In this case the emission has been attributed to bremsstrahlung radiation from electrons with a power law energy distribution $dN = KE^{-\gamma} dE$. The values of the spectral index and of the emission measure are given. A tentative interpretation of the event is suggested and the way to produce nonrelativistic electrons with a power law energy distribution is investigated. (auth)

18094 EVIDENCE FOR A COMMON ORIGIN OF THE ELECTRONS RESPONSIBLE FOR THE IMPULSIVE x-RAY AND TYPE III RADIO BURSTS. Kane, S. R. (Univ. of California, Berkeley). Solar Phys.; 27: No. 1, 174-181(Nov 1972).

Observations of impulsive solar flare x rays $\gtrsim$10 keV made with the OGO-5 satellite are compared with ground based measurements of Type III solar radio bursts at 10 to 580 MHz. It is shown that the times of maxima of these two emissions, when detectable, agree within ~18 s. This maximum time difference is comparable to that between the maxima of the impulsive x-ray and impulsive microwave bursts. In view of the various observational uncertainties, it is argued that the observations are consistent with the impulsive x-ray, impulsive microwave, and Type III radio bursts being essentially simultaneous. The observations are also consistent with 10-to-100-keV electron streams being responsible for the Type III emission. It is estimated that the total number of electrons $\gtrsim$ 22 keV required to produce a Type III burst is $\lesssim 10^{34}$. The observations indicate that the nonthermal electron groups responsible for the impulsive x-ray, impulsive microwave, and Type III radio bursts are accelerated simultaneously in essentially the same region of the solar atmosphere. (auth)

18095 POLARIZATION STRUCTURE OF A SOLAR FLARE REGION AT 9.5 mm WAVELENGTH. Kundu, M. R. (Univ. of Maryland, College Park); McCullough, T. P. Solar Phys.; 27: No. 1, 182-191(Nov 1972).

Polarization structure of an active region that produced a minor flare around 1900 UT on September 28, 1971 was measured at 9.5 mm wavelength using the 85-ft telescope of the Naval Research Laboratory Maryland Point Observatory. The angular resolution of the telescope at this wavelength is 1.6′. The flare region underwent changes both in the degree of polarization as well as in its polarization structure before and after the start of the flare. These changes in the degree of polarization correspond to a decrease of longitudinal magnetic field of about 200 G at the chromospheric levels where the 9.5 mm radiation originates. Observations on the polarization structure of active regions for several days before and after September, 1971 are also presented. (auth)

18096 METER-WAVELENGTH OBSERVATIONS OF THE SOLAR RADIO BURST STORM OF AUGUST 17-22, 1968. Stewart, R. T.; Labrum, N. R. (CSIRO, Sydney). Solar Phys.; 27: No. 1, 192-202(Nov 1972).

Meter-wavelength observations are presented for the solar radio storm of August 17-22, 1968. The data comprise dynamic spectra and high-resolution brightness distributions from the 80 MHz radioheliograph. It is found that the storm consisted essentially of Type III bursts at the lower frequencies and Type I at the higher frequencies; the transition, usually near 60 MHz, was fairly sharp. The Type I source was located over an active region associated with a large sunspot group. The Type III position was displaced about 0.5 $R_\odot$ transversely from the Type I, in a region of low magnetic field. The evident close association between the two types of emissions can best be explained by disturbances originating in the Type I region, propagating outwards through a region of weak magnetic field, and triggering an electron acceleration process, probably at the cusp of a "helmet" structure. The observed frequency and spatial relationship between the Type I and Type III components in events of this kind follow as a natural consequence of this model. A comparison of these results with the hectometer-wavelength satellite observations of the 1968 August event makes possible a qualitative estimate of the outward path of the Type III exciters through the corona, and it is apparent that below the solar-wind region of the corona this path departs considerably from the radial direction. (auth)

18097 LONG-TERM BEHAVIOR OF THE CIRCULAR POLARIZATION FROM CORONAL CONDENSATION RADIO EMISSION AT 4.3 cm WAVELENGTH. Paes de Barros, M. H.; Kaufmann, P. (Univ. Mackenzie, Sao Paulo, Brazil). Solar Phys.; 27: No. 1, 203-207(Nov 1972).

The circular polarization from coronal condensations at λ = 4.3 cm corresponds to the extraordinary mode of propagation, due to the contribution of preceding spots' polarities being usually left-handed. The fewer cases of right-handed polarization are normally associated to an excess of sunspot plages in the southern hemisphere, thus making it difficult to give evidence for magneto-ionic coupling phenomena as a general rule. (auth)

18098 TIME-LATITUDE DISTRIBUTION OF SOLAR FLARES ACCOMPANIED BY TYPE IV RADIO BURSTS DURING THE PERIOD 1956 TO 1969. Papagiannis, M. D. (Boston Univ.);

Zerefos, C. S.; Repapis, C. C. Solar Phys.; 27: No. 1, 208-216 (Nov 1972).

A list of nearly 350 flares accompanied by Type IV radio bursts by Krüger et al. (1971), which covers a period of 14 yr (1956-1969), was expanded to include all PCA and solar cosmic-ray events during this entire period. This list, which includes practically all of the most energetic events during the maxima of two consecutive solar cycles, was used to investigate the latitudinal distribution of the above-mentioned flares, as well as of all PCA events, solar cosmic-ray events and plage regions associated with them. Histograms of these occurrences show clearly the appearance of two peaks in both solar maxima, which confirm the observations of Gnevyshev (1967). Latitudinal analysis of these histograms shows that in cycle 20 the two peaks are independent and their relative strength varies strongly with latitude. In cycle 19, however, this effect is not clearly evident, possibly because of the extremely high level of activity during this cycle. In both cycles, the second maximum shows the highest concentration of the most energetic events. (auth)

18099 S- AND B-COMPONENTS OF SOLAR RADIO AND X-EMISSION AND THEIR RELATIONSHIPS TO ENERGETIC SOLAR EVENTS. Krueger, A. (Central Inst. for Solar-Terrestrial Physics, Berlin). Solar Phys.; 27: No. 1, 217-226(Nov 1972).

The slowly varying solar radio and x-ray emissions are considered theoretically and statistically concerning their significance as potential indicators of energy storage processes in active regions leading to large flare-burst events. A correlation analysis was carried out in order to test different global emission parameters accessible by daily routine measurements regarding their connection with Type IV bursts and proton flares. From all investigated quantities systematically best (though not very high) correlations were verified for both the 3 cm radio and 0-to-8-Å x-ray fluxes. Increasing correlation coefficients resulted for running averages indicating possible storage processes over several days. There was some evidence favoring the assumption of a small contribution of nonthermal processes to the spectrum of the S-component at burst-active periods which possibly lead to the development of flare–burst instabilities. (auth)

18100 SECTORIAL ANISOTROPY OF SOLAR COSMIC RAYS. Duggal, S. P.; Pomerantz, M. A. (Bartol Research of Foundation of the Franklin Inst., Swarthmore, PA). Solar Phys.; 27: No. 1, 227-241(Nov 1972).

A hitherto unobserved sectorial pattern of anisotropy that was limited to a narrow and stable region was displayed by the ground level event (GLE) of January 24, 1971. For the entire 1.5 h interval following onset before isotropy set in, the anisotropy was limited to a 10° cone centered about 60° from the spiral magnetic field line. It is also the first solar particle event for which it is possible, by analytical procedures based upon a theoretical propagation model, to distinguish between two rival candidates for the parent flare. (auth)

18101 NONLINEAR BOUSSINESQ CONVECTIVE MODEL FOR LARGE SCALE SOLAR CIRCULATIONS. Gilman, P. A. (National Center for Atmospheric Research, Boulder, CO). Solar Phys.; 27: No. 1, 3-26(Nov 1972).

Extensive numerical calculations are presented for a model of thermal convection of a Boussinesq fluid in an equatorial annulus of a rotating spherical shell. The convection induces and maintains differential rotation and meridian circulation. The model is solved for an effective Prandtl number P = 1, with effective Taylor number T in the range $10^2 < T < 10^6$, and effective Rayleigh number R between the critical value for onset of convection, and a few times that value. With $\Omega = 2.6 \times 10^{-6}$ s^{-1}, d = 1.4×10^{10} cm (roughly the depth of the solar convection zone) the range of Taylor number is equivalent to kinematic viscosities between 10^{14} and 10^{12} cm^2 s^{-1}, which encompasses eddy viscosities estimated from mixing length theory applied to the Sun. The convection does generally make equatorial regions rotate faster, the more so as T is increased, but local equatorial deceleration near the surface is also produced at intermediate T for large enough R above critical. The differential rotation is maintained primarily through momentum transport in the cells up the gradient, rather than by meridian circulation. Differential rotation energy increases relative to cell energy with increasing T, surpassing it near $T = 3 \times 10^4$. The differential rotation tends to stretch out the convective cells, analogously to what is thought to happen to solar magnetic regions. Differential rotation and meridian circulation energies are nearly equal for $T = 10^3$, but the meridian circulation energy falls off relative to differential rotation like T^{-1} for larger T. The meridian circulation is always toward the poles near the surface, contrary to models of Kippenhahn, Cocke, Köhler, and Durney and Roxburgh. The radial shear produced in the differential rotation is almost always positive, as in the Köhler model, but contrary to the assumptions made by Leighton for his random walk solar cycle model. Solutions in the neighborhood of $T = 3 \times 10^4$ seem to compare best with various solar observations including differential rotation amplitude, cell wavelength, tilted structure, horizontal momentum transport, and weak meridian circulation. The local equatorial deceleration (equatorward of 10 to 15°) has not been observed, although the techniques of data analysis may not have been sensitive to it. The most important deficiency of the model is that all the solutions with $T \geq 10^3$ show the vertical heat transport a rather strong function of latitude, with a maximum at the equator, no evidence of which is seen at the solar surface. (auth)

18102 SPECTRA OF NEAR-VERTICAL STRUCTURES ON THE SOLAR DISK. White, O.R. (High Altitude Observatory, Boulder, CO). Solar Phys.; 27: No. 1, 27-33(Nov. 1972).

Bright emission arches in the spectra of Hα and the Ca II (H and K lines) are identified as the spectroscopic picture of the chromospheric network as it appears near the solar limb. Analysis of the geometrical properties of these spectroscopic arches indicates that the average network is a diverging sheet with a divergence angle of ~ 50°. This sheet extends to 2600 km and 2000 km as an opaque emission feature in Hα and the Ca II (H and K) lines, respectively. (auth)

18103 Ca II K EMISSION ARCHES. Beebe, H.A. (New Mexico State Univ., University Park); Johnson, H.R. Solar Phys.; 27: No. 1, 34-38(Nov 1972).

Arch-like features are often seen in spectrograms of very strong lines near the solar limb when the slit crosses the chromospheric network. It is shown how earlier kinetic-equilibrium (non-LTE) calculations for Ca II can be used to predict such features for the K line with two-component atmospheric models. (auth)

18104 SIZE OF THE STRUCTURE ELEMENTS IN THE SOLAR CHROMOSPHERE. Krat, V.A. (Pulkovo Observatory, Leningrad). Solar Phys.; 27: No. 1, 39-43(Nov 1972).

Photometric reductions of the spectrograms obtained during the third flight of the Soviet Stratospheric Solar Station are discussed. A comparison of photometric scans in Hα and its far wings near to the continuum leads to the conclusion that chromospheric 'mottles' are at least several times broader than photospheric granules. The optimum size of mottles is about 0.8 to 1.1 in. The Hα profiles of mottles are practically the same as those obtained from the ground observations. The broadening of mottles is considered as an effect of expansion of magnetic arcs growing up to chromospheric levels. (auth)

18105 THERMAL CONDUCTIVITY IN SOLAR MAGNETO-PLAMAS. Yun, H.S.; Wyller, A.A. (Franklin Inst., Swarthmore, PA). Solar Phys.; 27: No. 1, 44-60(Nov 1972).

The work of Ulmschneider (1970) on the effective thermal conductivity of partially ionized plasmas was generalized to include the effects of magnetic fields. The contributions of electron, ion, and neutral heat flows were evaluated within the framework of the binary collision theory of Burgers (1960). In the temperature regime below 15000 K and pressures of 10^6 dyn cm^{-2} excellent agreement was obtained with the results of Ulmschneider for the transitional part of the nonmagnetic thermal conductivity. For higher temperatures a systematic discrepancy of a factor of 2 arises due to the lower order approximation in the kinetic treatment of the electrons in Burgers' theory. It is shown that the neutral component dominates heat transport in a solar magnetoplasma even at temperatures as high as 15000 K and that the magnetic modulations are of a secondary character. The application of the present theories to the sunspot models of Yun(1972) shows pronounced maxima in both electrical and thermal conductivities at the interface between umbra and penumbra. (auth)

18106 OSCILLATORY MOTIONS IN SUNSPOTS. Beckers, J.M. (Sacramento Peak Observatory, Sunspot, NM); Schultz, R.B. Solar Phys.; 27: No. 1, 61-70(Nov 1972).

Vertical velocity oscillations are observed in some sunspot umbrae with periods of about 180 s and peak to peak amplitudes up to 1 km s^{-1}. These oscillations are not visible in either the line depth, line width, or the continuum intensity. No correlation seems to exist between the occurrence of these oscillations and the presence of the chromospheric umbral flashes (Solar Phys. 7, 351, 1069). In the spot penumbra there is an indication of a long-period oscillation, the period increasing from about 300 s in the inner penumbra to nearly 1000 s at the penumbra–photosphere boundary. An attempt has been made to interpret these oscillations in terms of gravity or acoustic waves, travelling along the magnetic field lines, taking into account the variation of scale height and magnetic field direction across the sunspot. (auth)

18107 OSCILLATIONS AND WAVES IN A SUNSPOT. Giovanelli, R. G. (National Standards Lab., Sydney). Solar Phys.; 27: No. 1, 71-79(Nov 1972).

Observations were made in Hα of the vertical velocity distribution in a sunspot. Over the umbra the pattern consisted of structures of scale-size 2 to 3 in. The velocity distribution undergoes oscillations with a period of about 165 s and typical amplitude ±3 km s^{-1}, but the pattern breaks down after one or two cycles because the period of oscillation varies typically by ±20 s from place to place. Transverse waves develop in the outer 0.1 of the umbral radius and propagate outwards with a velocity of about 20 km s^{-1}, becoming gradually invisible by or before the outer penumbral boundary; the amplitude is about ±1 km s^{-1} at the umbra-penumbra border. The penumbral waves are believed to be basically of the Alfvên type, with $\rho \approx 3 \times 10^{-8}$ g cm^{-3}. The umbral oscillations presumably represent gravity waves. In both cases the fluxes are inadequate by two orders of magnitude to account for the sunspot energy deficit. (auth)

18108 OBSERVATIONS OF SUNSPOT UMBRAL VELOCITY OSCILLATIONS. Bhatnagar, A. (Carnegie Institution of Washington, DC); Livingston, W.C.; Harvey, J. W. Solar Phys.; 27: No. 1, 80-88(Nov 1972).

Sunspot umbral molecular lines were used to look for the oscillatory velocities in the umbra. Power spectrum analysis showed conspicuous power for periods in the range between 448 and 310 s. The maximum peak-to-peak amplitude of the umbral oscillatory velocity component was observed to be in the order of 0.5 km s^{-1}. (auth)

18109 PERIODICITIES IN THE LONGITUDE DISTRIBUTION OF SUNSPOTS. Stanek, W. (Eidgenoessische Sternwarte, Zurich). Solar Phys.; 27: No. 1, 89-106(Nov 1972).

It is well known to the observer of sunspots that the spots seem not to be randomly distributed on the solar surface but rather occur at an increased rate at distances of 180° of each other on the same hemisphere while northern and southern hemispheres are independent. The following investigation—based on observational data of rotations No. 1457-1568 (1962-1970)—shows four main results: (1) Northern and southern hemispheres behave independently. (2) Each hemisphere can be divided in longitude into sections of 45° so that successive sections alternatively show higher and lower spot occurrence. In other words, maximum spot occurrence is found in intervals of about 90° and 180°. (3) Second-order peaks can be found in intervals of 30° and multiples of it. The spot maxima explained above coincide with some of these second-order peaks. (4) Areas of minimal spot occurrence can be traced over a long period of time. These areas can be understood as the center of long-living magnetic areas along the borders of which is found the so-called "streets of prominences" with its spots. This theory of Stanek (1971) explains the occurrence of prominences. Because of the steep magnetic gradient along these streets the theory is expected to hold true even for spots. This leads to a better understanding of the pattern already known and now being generalized to "streets of activity." (auth)

18110 MEASUREMENTS OF THE SOLAR SPECTRUM BETWEEN 30 AND 128 A. Manson, J. E. (Cambridge Research Labs., Bedford, MA). Solar Phys.; 27: No. 1, 107-129(Nov 1972).

The results of two rocket flights of grazing incidence monochromators designed to measure solar line intensities in the wavelength between 30 and 128 Å are compared. One of these flights sampled a very quiet Sun, that of November 3, 1965, and has been reported previously. The other acquired data during a more active, but nonflaring, interval on August 8, 1967. Improvements in the data reduction techniques have led to a refinement in the former data, and these improvements together with instrumental changes provided increased resolution in the results from the latter flight. The changes in line intensities observed in these two experiments follow a pattern which is in general qualitative agreement with theoretical ionization equilibrium calculations for the solar corona. An analysis of these and other observations of the C VI Lα line suggests that this line is particularly sensitive to local solar activity. (auth)

18111 FURTHER IDENTIFICATIONS IN THE Ar XI SPECTRUM. Connerade, J. P. (European Space Research Inst., Frascati, Italy). Solar Phys.; 27: No. 1, 130-131(Nov 1972).

Experimental wavelengths obtained by various workers in the 35.6 to 33.8 Å region are given along with a list of calculated wavelengths. (WDM)

18112 RADIO OPTICAL DEPTH OF THE LAYER WHERE THE TEMPERATURE EQUALS THE BRIGHTNESS TEMPERATURE. Drago, F.C. (Osservatorio Astrofisico di Arcentri, Florence). Solar Phys.; 27: No. 1, 132-136(Nov 1972).

It is usually believed that the radio optical depth of the layer h* where the temperature equals the brightness temperature is independent of the frequency. This assumption is criticized from the theoretical point of view and the behavior of $\tau(h^*)$ as a function of the frequency ν is computed for two different solar models. (auth)

18113 MODEL FOR THE STEADY STATE INTERACTION OF THE SOLAR WIND WITH THE MOON. Catto, P. J. New Haven; Yale Univ. (1972). 131p. University Microfilms Order No. 73-1.

Thesis (Ph. D.).

The solar wind is a magnetized stream of charged particles emitted continuously by the sun. The steady state interaction of the solar wind with the Moon is modeled as a uniform, magnetized, quasi-neutral, collisionless, hypersonic, and hyper-Alfvénic flow of an electron—proton plasma past a perfectly ion absorbing, nonmagnetized sphere. The electron and proton densities and mean velocities are assumed to be equal nearly everywhere. Three different limits of steady state equations are derived from the reduced Vlasov equations and the associated equations of the reduced description by both an ordering scheme that allows for the possibility of different scale lengths along the magnetic field B and along the center of mass velocity, and by an expansion in two small parameters that effectively measure the smallness of gradient B and electron thermal terms compared to a dominant term retained. The limit applicable to a particular problem is found to depend on the size of a dimensionless parameter which is the product of the parameter measuring the smallness of gradient B terms and the square of the ratio of the Alfvén to the ion thermal speeds. The less complicated of the two more appropriate limits is then applied to the steady state Moon—solar wind interaction. A numerical solution of this limit is presented and discussed. A technique is presented whereby the three limits can be approximately extended to cases in which the electron thermal terms are comparable or larger than a dominant term retained. (Diss. Abstr. Int., B)

18114 PHYSICS OF THE SOLAR CORONA. Proceedings of NATO Advanced Study Institute Held at Cavouri-Vouliagmeni, Athens, Greece, September 6–17, 1970. Macris, C. J. (ed.). Astrophysics and Space Science Library, Volume 27. New York; Springer-Verlag New York Inc. (1971). 358p. $28.60. (CONF-700983).

Separate titles are given for 20 of the 21 papers presented. (WDM)

For titles of individual papers see: 18004, and 18115–18133.

18115 CHROMOSPHERE-CORONA TRANSITION REGION. Athay, R. G. (High Altitude Observatory, Boulder, CO). (Astrophys. Space Sci. Libr.). 27: 36-65(1971).

From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).

See CONF-700983-.

18116 CORONAL MAGNETIC FIELDS. Newkirk, G. Jr. (High Altitude Observatory, Boulder, CO). (Astrophys. Space Sci. Libr.) 27: 66-87(1971).

From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).

See CONF-700983-.

18117 EXTENDED CORONAL MAGNETIC FIELD. Wilcox, J. M. (Univ. of California, Berkeley). (Astrophys. Space Sci. Libr.) 27: 88-96(1971).

From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).

See CONF-700983-.

18118 INVESTIGATION ON CORONAL MONOCHROMATIC EMISSIONS IN THE OPTICAL RANGE. Dollfus, A. (Observatoire de Paris, Meudon). (Astrophys. Space Sci. Libr.) 27: 97-113(1971).

From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).

See CONF-700983-.

18119 CORONAL EVENTS OBSERVED IN 5303 A. Dunn, R. B. (Sacramento Peak Observatory, Sunspot, NM). (Astrophys. Space Sci. Libr.); 27: 114-129(1971).

From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).

See CONF-700983-.

18120 SOLAR CORONA IN THE ELEVEN-YEAR CYCLE. Waldmeier, M. (Swiss Federal Observatory, Zurich). Astrophys. Space Sci. Libr.; 27: 130-139(1971).

From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).

See CONF-700983-.

18121 CORONAL ACTIVE REGIONS AND FLARE-ASSOCIATED EVENTS. Zirker, J. B. (Univ. of Hawaii, Honolulu). Astrophys. Space Sci. Libr.; 27: 140-155(1971).
From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18122 OBSERVATIONAL EFFECTS OF FLARE-ASSOCIATED WAVES. Smith, S. F.; Harvey, K. L. Astrophys. Space Sci. Libr.; 27: 156-167(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18123 SURGES. Macris, C. J. (Research Center for Astronomy and Applied Mathematics, Athens). Astrophys. Space Sci. Libr.; 27: 168-178(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18124 RELATIONS BETWEEN THE AREAS INDEX AND DIFFERENT PHENOMENA IN THE CHROMOSPHERE, THE CORONA, AND THE INTERPLANETARY SPACE. Xanthakis, J. (Research Center for Astronomy and Applied Mathematics, Athens). Astrophys. Space Sci. Libr.; 27: 179-191(1971).
From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18125 MODELS OF THE QUIET AND ACTIVE SOLAR ATMOSPHERE FROM HARVARD OSO DATA. Noyes, R. W. (Smithsonian Astrophysical Observatory, Cambridge, MA). 27: 192-218(1971).
From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18126 DETERMINATION OF CHROMOSPHERIC-CORONAL STRUCTURE FROM SOLAR XUV OBSERVATIONS. Jordan, C.; Wilson, R. (Astrophysic Research Unit, Culham, Eng.). Astrophysics. Space Sci. Libr.; 27: 219-236(1971).
From Physics of The Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18127 X-RAY SPECTROSCOPY OF SOLAR ACTIVE REGIONS AND FLARES. Neupert, W. M. (Goddard Space Flight Center, Greenbelt, MD). Astrophys. Space Sci. Libr.; 27: 237-253(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18128 NOTE ON A RECENT IDENTIFICATION OF THE SOLAR FLARE 1.9 A LINE FEATURE. Phillips, K. J. H. (Univ. Coll., London). Astrophys. Space Sci. Libr.; 27: 254-256(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18129 RECENT INVESTIGATIONS ABOUT SOLAR X-RAYS EMITTED BY THE SOLAR CORONA BY MEANS OF SOLRAD SATELLITES. Landini, M.; Monsegnori Fossi, B. C. (Arcetri Astrophysical Observatory, Florence). Astrophys. Space Sci. Libr.; 27: 257-266(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18130 RADIO EMISSION OF THE QUIET SUN. Felli, M.; Tofani, G. (Osservatorio Astrofisico di Arcetri, Florence). Astrophys. Space Sci. Libr.; 27: 267-286(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18131 SOLAR BURSTS AT DECAMETER AND HECTOMETER WAVELENGTHS. Kundu, M. R. (Univ. of Maryland, College Park). Astrophys. Space Sci. Libr.; 27: 287-307(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18132 MODELS OF THE SOLAR TRANSITION REGION CHROMOSPHERE-CORONA. Noci, G. (Osservatorio Astrofisico di Arcetri, Florence). Astrophys. Space Sci. Libr.; 27: 308-316(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18133 STUDIES OF THE OUTER CORONA THROUGH SPACE RADIO ASTRONOMY. Papagiannis, M. D. (Boston Univ.). Astrophys. Space Sci. Libr.; 27: 317-332(1971).
From Physics of the Solar Corona Conference; Athens, Greece (6 Sep 1970).
See CONF-700983-.

18134 CHEMICAL COMPOSITION OF THE SUN AND THE FORMATION OF THE ELEMENTS. Engvold, O. (Univ. of Oslo). Astron. Tidsskr.; 5: No. 3, 121-124(1972). (In Norwegian).
Five methods of determining the chemical composition of the Sun are stated and a figure shows the quantitative distribution of the elements by atomic number, based on such measurements. This distribution is interpreted, and its relation to the composition of other stars and the pre-solar gas cloud discussed. Mechanisms for the formation of the heavier elements are mentioned. Finally three mechanisms are presented whereby stars, which produce heavy gases, lose mass to the interstellar medium from which new stars are formed. This leads to the oldest stars having lower amounts of the heavier elements than the younger stars. (NO)

18135 NATURAL REMANENT MAGNETIZATIONS OF CARBONACEOUS CHONDRITES AND THE MAGNETIC FIELD IN THE EARLY SOLAR SYSTEM. Banerjee, S. K. (Univ. of Minnesota, Minneapolis); Hargraves, R. B. Earth Planet. Sci. Lett.; 17: No. 1, 110-119(Dec 1972).
The natural remanent magnetizations (NRM) of three carbonaceous chondrites, Allende (Type III), Murchison (Type II), and Orgueil (Type I), were studied in an attempt to explain the origin of the stable component of their NRM which is greatest in Allende and least in Orgueil. Thermal demagnetization of NRM and remagnetization in a known field were observed using a spinner magnetometer in conjunction with a zero-field vacuum furnace and an alternating field demagnetizer; high field thermomagnetic properties were studied using a Curie balance. Additional work involving reflected light microscopy and electron probe microanalysis were carried out on polished sections to characterize the carriers of NRM. Results suggested that these remanences were acquired at temperature lower than 135°C. Inconsistent data were obtained on heating above 135°C. Using results below this temperature and on the assumption that the acquisition process was thermoremanence, it was deduced that the ambient magnetic fields during the formation of these primitive meteorites were between 0.2 and 1.1 Oe. The latter figure was obtained from Allende and was considered to be more reliable than the other two. If, in fact, the remanences were acquired by processes other than thermoremanence, the above values are to be regarded as lower limits. In any case, these figures for a primordial magnetic field are about 10^4 times greater than the present interplanetary field. Such values are in accord with those cosmological theories which require very large magnetic fields to have been present during the formation of the solar system. (auth)

18136 NATURAL REMANENT MAGNETIZATION AND THERMOMAGNETIC PROPERTIES OF THE ALLENDE METEORITE. Butler, R. F. (Stanford Univ., CA). Earth Planet. Sci. Lett.; 17: No. 1, 120-128(Dec 1972).
Paleomagnetic examination of a 1-kg specimen of the Allende meteorite revealed the existence of natural remanent magnetization of constant direction and moderate intensity (3.0×10^{-4} emu/g). Cooling of the fusion crust in the Earth's magnetic field following atmospheric entry has remagnetized the outer 1 mm of the specimen. Comparison of AC demagnetization spectra of NRM with spectra of laboratory-produced remanence suggests that the natural remanence is thermal or thermochemical remanence formed during original accretion or post-accretion reheating of Allende. Paleointensity determinations on three samples show that the NRM was formed in a field of approximately 1.1 Oe. Thermomagnetic analysis indicates that the ferromagnetic minerals in Allende consist of 95% taenite containing 67% Ni plus 5 wt% taenite with 36% Ni. These iron–nickel minerals amount to only 0.46 wt% of the whole rock. (auth)

18137 ORIGIN OF THE SOLAR SYSTEM. Pine, R. M. R. New York; Yeshiva Univ. (1972). 138p. University Microfilms Order No. 73-1105.
Thesis (Ph. D.).
An assumed two solar mass, uniformly rotating spherical frag-

ment of a collapsing interstellar gas cloud is used to construct probable numerical models of the primitive solar nebula. Two types of spheres were considered, one where the density was uniform, and one where the density fell linearly from center to zero at the surface. These defined the angular momentum per unit mass as a function of mass fraction. The spheres were flattened into disk shapes, and equilibrium between pressure gradient, gravitational and centrifugal forces was found in the radial direction, with every point conserving its angular momentum per unit mass. In the vertical direction equilibrium was found between pressure gradient and gravitational forces. Energy transport in the vertical direction is by convection and radiation. The main contributors to the opacity at low temperatures were iron grains and ice. The opacity was computed in the limit that chemical equilibrium existed in the primitive solar nebula allowing the metallic iron to form trolite and iron oxide bound in silicates at lower temperatures and in the limit that chemical equilibrium did not exist at all and the iron remained metallic down to the lowest temperatures. These two opacity limits were used on the two models to give four possible vertical structures. Two convective regions appeared in each model, an inner one due to dissociation of hydrogen molecules, and an outer one due to the high opacity of metallic iron grains. The semi-thickness of the disk ranged from about 0.1 AU near the center to 1 AU near the outside. Radiation lifetimes and angular momentum transport times from a few years near the center to about 10^4 years at about 10 AU were estimated. (Diss. Abstr. Int., B)

18138 SOLAR ACTIVE REGION FROM AUGUST 17–30, 1971 AND ASSOCIATED EVENTS. Tifrea, E.; Dimitriu, A. (Observatorul Astronomic, Bucharest). Stud. Cercet. Astron.; 17: No. 2, 197-202(1972). (In Rumanian).

A morphological analysis is given of the McMath 11482 active region. There were some evident changes in the photospheric structure, but not a very high activity in the chromosphere. The surges and bright points were main events of this region. The data of 3 flares observed at the Bucharest Observatory are also given. (auth)

18139 EPICYCLIC MOTION OF STARS AT DIFFERENT REGIONS OF THE GALAXY. Ray, A. K. (Jadavpur Univ., Calcutta). Stud. Cercet. Astron.; 17: No. 2, 235-243(1972).

Sizes of the epicycles at different distances from the galactic center are discussed. It is found that the sizes increase with the distance from the center indicating that the mixing of stars of larger volume takes place going away from the center. The ellipses are more elongated in the transverse direction going away. The Sun's distance from the center of the Galaxy change by 2 kpc. (auth)

18140 NEW RESULTS OF X-RAY FLARE STUDIES. Mandelstam, S. L. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 307-18(1972). (In Russian).

Measurements carried out with the satellites "Intercosmos-1" and "Intercosmos-4" showed a considerable polarization of the x-ray emission in the 10 to 20-keV range during the initial "impulsive" phase of solar flares. This shows that the hard x-rays of the solar flares are produced by directed beams of accelerated energetic electrons. Investigations of the x-ray flare spectra, carried out with Bragg crystal spectrometers with high spectral resolving power, show lines of ions Fe XXV, Fe XXIV, and Fe XXIII; the important role of dielectronic recombination process is confirmed. The electron temperature of the flare plasma is about 15 to 20×10^6°K and ion temperature 12 to 15×10^6°K measured by the Doppler width of Mg XII lines. (auth)

18141 EFFECT OF SOLAR ACTIVITY DELAYS ON THE PROCESSES IN SOLAR-TERRESTRIAL SPACE. Velinov, P. I. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 8, 1045-1048(1972).

Some unexplained processes in Sun–Earth space were correlated with the pauses or delays of solar activity. The effect of the solar activity delays on the ionospheric nighttime disturbances for 1948 to 1963 was compared with the effect of solar accelerations and appears to be equal. A monthly analysis was made of the index of geomagnetic activity in the 1959 to 1970 period, and the effects of the delays were investigated. The contribution of solar delays at different time intervals for each day from sunset to midnight, January to December 1970—a period of 293 days—was analyzed. It is concluded that the effect of delays of velocity of solar activity, independent of the time of day, on the daily, monthly, and annual course of natural events is considerable. (JCW)

Galaxies

18142 (MATSCIENCE-72) LECTURE NOTES ON GRAVITATIONAL COLLAPSE AND GRAVITATIONAL RADIATION. Prasanna, A. R. (Institute of Mathematical Sciences, Madras (India)). [nd]. 73p. Dep. NTIS (U. S. Sales Only).

This report consists of the material presented in a course of lectures on advanced topics in the theory of gravitation at the Institute of Mathematical Sciences, Madras, during 1971. Starting with a study of the Schwarzschild singularity, the gravitational implosion problem was studied through various solutions. In this context the problems associated with boundary conditions in general relativity and with singularities are considered. The quadrupole nature of gravitational radiation is established and some exact solutions representing gravitational radiation fields are presented. (WDM)

18143 COLORIMETRY OF THE GALAXY NGC 6946. II. Integral Photometric Characteristics of Bright Stellar Associations. Khachikyan, E. E.; Saakyan, K. A. (Byurakan Astrophysical Lab., Erevan). Astrophysics (Engl. Transl.); 6: No. 2, 81-91 (1970).

Translated from Astrofizika; 6: No. 2, 177-190(1970).

The results of two-color photometric studies of bright associations in the spiral galaxy NGC 6946 are reported. The stellar magnitudes and (B–V) color indices were measured for 148 associations. Their absolute magnitudes are estimated. A chart is given showing the distribution of the associations over the galaxy. The distance to the galaxy is estimated. (auth)

18144 ESTIMATED BRIGHTNESS OF SELECTED MARKARYAN GALAXIES. Dibai, E. A. Astrophysics (Engl. Transl.); 6: No. 2, 185-187(1970).

Translated from Astrofizika; 6: No. 2, 350-354(1970).

Photoelectric measurements of the brightness and color of twenty objects in the second Markarian list (1969) are reported. Most of them exhibit emission in the visible part of the spectrum. The observations were performed in Nov. 1969, using the 125-cm reflector of the Crimean Station of the Shternberg Institute. (WDM)

18145 EQUATION FOR THE PHASE DENSITY IN A SYSTEM OF GRAVITATING POINTS. Terebizh, V. Yu. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 6: No. 2, 182-184(1970).

Translated from Astrofizika; 6: No. 2, 346-350(1970).

The evolution of a stellar system in a regular self-consistent gravitational field is described by the Boltzmann–Liouville and Poisson equations. The fact that these equations are partial differential equations is an important complication in both the analytic and numerical analysis. An integral kinetic equation for the Fourier transform of the phase density was therefore derived. (WDM)

18146 PATCHY MODEL OF RADIO-EMITTING CLOUDS IN RADIO GALAXIES. Melik-Alaverdyan, Yu. K. (Byurakan Astrophysical Observatory, Erevan). Astrophysics (Engl. Transl.); 6: No. 2, 178-181(1970).

Translated from Astrofizika; 6: No. 2, 341-345(1970).

A radio source model consisting of individual condensations has been discussed by Burbidge (1967). Within the framework of the Ambartsumyan theory of radio galaxies (1968) these condensations may be looked upon as a result of the fragmentation of prestellar material ejected from the nucleus of the galaxy. Moreover, these condensations are regions of enhanced magnetic field, i.e., magnetized clouds. For the sake of simplicity, the field between the clouds is assumed to be zero. Certain definite requirements with regard to the structure of such a cloud are formulated. (WDM)

18147 ANDROMEDA GALAXY M31. III. Hydrodynamic Model. Results. Einasto, J.; Ruemmel, U. Astrophysics (Engl. Transl.); 6: No. 2, 120-132(Jan 1973).

Translated from Astrofizika; 6: No. 2, 241-259(1970).

The mass distribution model described in previous papers in this series was used to determine, for the axis and the plane of symmetry of M31, the following kinematic functions: the velocity dispersions in the radial and vertical directions; the centroid velocity; the ratio of the squares of the dispersions, and the parameter $\gamma = \frac{1}{2} \tan 2\alpha$, where α is the inclination of the major axis of the velocity ellipsoid to the plane of the galaxy. The functions were determined for the individual components (flat component, disk, central bulge with halo, and the nucleus). Taking into account the thickness of the galaxy, the dynamic functions were recalculated, namely, the circular velocity V_c, and the Oort–Kuzmin parameters A_c, B_c, C_c. The maximum value of the circular velocity was found to be 328 km/sec at 1 kpc from the center. In general, the results are in

agreement with values which one would expect by analogy with our own Galaxy. The radial velocity dispersion at the center of the galaxy calculated from the model is less than the observed dispersion. The mass distribution model can be improved by taking this difference into account. The angular momentum per unit mass of the spheroidal component (bulge) is lower by a factor of at least 4.5 than the mean. This can be explained by two factors, namely, a) the stellar formation process during the initial phase of development of the galaxy was localized in the inner part of the galaxy with low specific angular momentum, and b) the spheroidal component has lost its outer layers. (auth)

18148 MORPHOLOGY AND PHOTOMETRY OF SOUTHERN GALAXIES. Dottori, H. A. (National Univ., Cordoba, Argentina). Bol. Inst. Mat., Astron. Fis.; 3: No. 2, 5-23(1968). (In Spanish).

The morphology of six southern galaxies is outlined by a description of the system of which it forms a part, a description of the object, possible effect of its complement, apparent dimensions of the galaxy, and comparison with other galaxies which have approximately the same subsystems. The photometry program is given. (JSR)

18149 STRUCTURE IN THE SOLAR NEIGHBORHOOD. STUDY OF STAR TROOPS, STAR FAMILIES, AND STAR STREAMS. Hopmann, Josef. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Sitzungsber., Abt. II; 180: No. 7, 247-97(1972). (In German).

Earlier work on wide pairs, multiple stars, star troops, and star streams is reviewed. Topics considered in detail include the two troops near 107 Aqa, the Schütte family IV a4, the Fisher criterion, the moving cluster in PsA, the family III i3, Schütte's work, extreme stars (hyperbolic orbits), family of the Sun, statistical studies on all Schütte stars, the twelve star streams, and a model of the solar neighborhood. (WDM)

18150 NEUTRAL HYDROGEN SURVEY OF THE GALAXY M33. I. OBSERVATIONS. Huchtmeier, W. (Observatory, Meudon, France). Astron. Astrophys., Suppl. Ser.; 7: No. 4, 397-416(Dec 1972).

A survey of the neutral hydrogen of the nearby galaxy M33 was performed with the 200 m transit telescope of Meudon Observatory. A bandwidth of 60 kHz (12.7 km s^{-1}) and a telescope beamwidth at half power of 4 min of arc in right ascension and 24 min of arc in declination were used to get detailed information on the HI in this galaxy. The equipment, the methods of observation, and data reduction are described and the observations are presented as drift scans, which give the most detailed information on the observational material. (auth)

18151 INTERSTELLAR MOLECULES AND COSMOCHEMISTRY. Conference Held in New York, NY, June 16–18, 1971. Johnson, F. M. (ed.). Ann. N. Y. Acad. Sci.; 194: 1-101(3 May 1972). (CONF-710660).

This conference was organized to discuss advances in the field of interstellar molecules and their implications for cosmochemistry. Original contributions as well as survey papers are included on spectroscopy of the interstellar medium, optical and microwave observations, interstellar dust, abundances of interstellar molecules and laboratory spectroscopy, the interplanetary medium, and cosmochemistry. (WDM)

18152 AXIALLY SYMMETRIC EXPLOSION IN A SPHEROID. Sakashita, S. (Hokkaido Univ., Sapporo). Astrophys. Space Sci.; 14: No. 2, 431-437(Dec 1971).

The method of Laumbach and Probstein is applied to a point explosion in a spheroid with exponential density distribution. It is shown that the shock-wave propagates strongly along the direction of symmetry axis and the envelope of the shock front elongates to the same direction. The rate of elongation of the shock envelope increases with the eccentricity of the spheroid and finally the blow-out of the shock wave along the polar axis occurs when the eccentricity exceeds some critical value. It is suggested that such a blowout of the shock may be connected with some galactic outburst having axial symmetry. (auth)

18153 EVOLUTIONARY STAGE OF STARS IN THE DRACO DWARF GALAXY. Caputo, F. (Laboratorio di Astrofisica Spaziale, Frascati, Italy); Castellani, V. Astrophys. Space Sci.; 14: No. 2, 323-331(Dec 1971).

An analysis of the color–magnitude diagram of stars in Draco dwarf galaxy was performed on the basis of Baade and Swope observational results. Some evidence was found for the occurrence of a clump in the luminosity distribution of red-giant stars. By combining this characteristic with the morphology of the horizontal branch, a suggestion was obtained for accepting high helium content ($Y \simeq 0.30$) with a relatively small age (1 to 2×10^9 yr) for the evolving stars. Some correlations among lifetimes of evolutionary stages were derived. (auth)

18154 JET IN M 87. Stewart, P. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 14: No. 2, 261-264(Dec 1971).

The jet is assumed to be ejected from the nucleus supersonically into a gas which is at rest; the knots that result are related to those which are observed and an estimate of the jet temperature follows. The magnetic field and particle density inside the jet are discussed and observations are suggested. (auth)

18155 INFRA-RED EMISSION FROM GALACTIC NUCLEI. Apparao, K. M. V.; Rengarajan, T. N. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 14: No. 2, 460-463 (Dec 1971).

It has been suggested by several authors that the infrared emission from galactic nuclei is due to synchrotron process from compact objects or due to thermal processes. The coherent and incoherent synchrotron mechanisms from compact objects were examined and it was found that these are unlikely to explain the observed emission. (auth)

18156 TIME VARIATION OF METAL ABUNDANCE IN GALAXIES. SUPER-METAL-RICH STAGE. Ikeuchi, S.; Sato, H.; Sato, T.; Takeda, H. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1885-1898(Dec 1972).

Time variation of metal abundance Z in the interstellar gas was studied and it was found that the abundance Z does not necessarily increase monotonously with time. Super-metal-rich stars are explained as the stars formed during the peak stage of Z, which appeared at $(1 \pm 0.5) \times 10^9$ years after the start of star formation in galaxies. After the peak stage, the metal abundance approaches some constant value, which is determined by the final stellar structure and the mass spectrum of stars. (auth)

18157 OBSERVATIONS OF THE OUTER SPIRAL STRUCTURE OF THE MILKY WAY AND ITS RELATION TO THE HIGH VELOCITY CLOUDS. Davies, R. D. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 4, 381-406(1972).

New observations have been made of the neutral hydrogen emission from the outer spiral structure of the Milky Way. A number of new arms with densities about 1 per cent of the well-known spiral arms have been discovered at distances of 15 to 20 kpc from the galactic center. The bands of high velocity clouds (HVCs) appear to fan upwards from these outermost spiral arms in a trailing sense. It is suggested that the tilt in the galactic plane and the asymmetrical distribution of the HVCs is produced by a close passage of the Large Magellanic Cloud. A few HVCs having velocities incompatible with galactic rotation are also believed to be a consequence of this interaction. (auth)

Cosmology

Refer also to abstracts 18510, 18542, and 18554.

18158 (JINR-E2-6831) GLOBAL PROPERTIES OF COLLAPSING MATTER (BLACK HOLES). Markov, M.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 49p. (CONF-721207-1). Dep. NTIS (U.S. Sales Only).

From 6th Texas symposium on relativistic astrophysics; New York (18 Dec 1972).

One of the criteria of the existence of fields outside black holes, namely the incompatibility of the presence of the sources of a field with the possible formation of the closed metric, is considered. Some arguments in favor of the existence of the external massive vector (baryon) fields of black holes are given. It is stressed that a correct nonstandard treatment is needed for the problem to be solved rigorously. (auth)

18159 EXTERNAL GALAXIES AND QUASI-STELLAR OBJECTS. International Astronomical Union Symposium No. 44 Held in Uppsala, Sweden, August 10–14, 1970. Evans, D. S. (ed.). New York; Springer-Verlag New York Inc. (1972). 563p. $35.60. (CONF-700864).

The field covered by the eighty-one papers and survey lectures extends all the way from observational studies both in the optical and radio regions of the spectrum to the elaboration of theories of the origin of concentrated sources and their reconciliation with cosmological ideas. It includes classification of galaxies, especially those known as compact, statistical studies of the distribution of radio sources, and relativistic cosmology. (WDM)

18160 FRAGMENTATION OF A HOMOGENEOUS MEDIUM UNDER THE ACTION OF GRAVITATION. Zel'dovich, Ya. B.

(Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 6: No. 2, 164-174(1970).

Translated from Astrofizika; 6: No. 2, 319-335(1970).

An approximate solution is obtained for the growth of perturbations in an expanding medium at zero pressure. The solution is qualitatively correct even when the perturbations are not small. An initially infinite density is obtained on a disk-like surface as a result of unilateral compression. The following layers are compressed first adiabatically and then by a shock wave. The physical conditions in the compressed material are analyzed. (auth)

18161 BULK VISCOSITY IN RELATIVISTIC HOMOGENEOUS ISOTROPIC COSMOLOGIES. Nightingale, J. D. Hoboken, NJ; Stevens Inst. of Tech. (1972). 168p. University Microfilms Order No. 72-31,172.

Thesis (Ph. D.).

Bulk viscosity is introduced into the stress–energy tensor of the cosmological fluid for those Friedmann universes which have $\epsilon = 0$. Equations are obtained for the modification of the Robertson–Walker-metric scale-factor (IR), the energy-density (ϵ), and the Hubble-related age. An explicit form for the coefficient of bulk-viscosity is then found by means of the relativistic Boltzmann equation, solved by the Grad method of moments. It is found that, to a first approximation (using a Jüttner-type distribution function) none of the three transport coefficients (bulk viscosity, shear viscosity, and thermal conductivity) involve the Hubble constant. Graphs are given for the coefficient of bulk viscosity versus temperature, also for the ratio of specific heats of a relativistic gas. The high value of dimensionless entropy per baryon associated with the present background radiation of the Universe cannot therefore be accounted for on the basis of a bulk-viscous mechanism. The effects of bulk viscosity in cosmology appear negligible, except in calculations involving relative abundances, where the time spent in particular temperature ranges would be important. (Diss. Abstr. Int., B)

18162 IS THE UNIVERSE TRANSPARENT OR OPAQUE. Davies, P. C. W. (Cambridge Univ., Eng.). J. Phys., A (London); 5: No. 12, 1722-1737(Dec 1972).

The maximal class of conformally flat cosmological models which eventually absorb all the electromagnetic radiation they contain is determined. This is the requirement of the Wheeler–Feynman absorber theory of radiation. Existing literature on the subject contains many serious errors. In this paper the condition for complete absorption is given and the various cosmological models tested by inspection. Some of the existing errors concerning the refractive index of the intergalactic medium, and the past absorber are examined in some detail. Of the Friedmann cosmologies, only the oscillating models are opaque. A number of ever-expanding nonrelativistic cosmologies, such as the Dirac and the latest Hoyle–Narlikar models, are also opaque. An assessment of the present value of the Wheeler–Feynman theory is given in the light of recent work on its quantization. (auth)

18163 UNIVERSE FILLED WITH MAGNETOFLUID. Date, T. H. (Shivaji Univ., Kolhapur, India). Curr. Sci. (India); 42: No. 1, 15-16(5 Jan 1973).

A solution corresponding to an expanding nonuniform model universe is obtained for the field equations of relativistic magnetohydrodynamics proposed by Lichnerowicz (1967). (WDM)

18164 ORIGIN OF MAGNETIC FIELDS IN THE EARLY UNIVERSE. Harrison, E. R. (Univ. of Massachusetts, Amherst). Phys. Rev. Lett.; 30: No. 5, 188-190(29 Jan 1973).

Primordial turbulence in the radiation era generates a weak seed magnetic field on all scales of the turbulence. This field is stochastically amplified by turbulence motions, and it is possible for magnetic and small-scale kinetic energies to attain equipartition within an expansion time. Field generation ceases at the epoch of equal radiation and matter densities, when the field strength is of the order of 1 G. It is estimated that the present intergalactic field has an intensity of $\sim 10^{-8}$ G and a scale-length of ~ 1 Mparsec. (auth)

18165 PRELIMINARY QUASAR MODEL BASED ON THE YILMAZ EXPONENTIAL METRIC. Clapp, R. E. (Basic Research Associates, Inc., Cambridge, MA). Phys. Rev., D; 7: No. 2, 345-355(15 Jan 1973).

A partially collapsed spherical matter distribution is analyzed with the aid of an integral equation for the gravitational potential, derived from the Yilmaz exponential metric. This metric equals the Schwarzschild metric for weak gravitational fields but differs for strong fields, avoiding any catastrophic collapse into a black hole. The quasars are interpreted as gravitationally compacted protogalaxies, with galactic masses and dimensions which are initially stellar but increase as the quasar evolves into a galaxy. Good agreement is found between the surface redshifts calculated from the preliminary quasar model and the observed redshifts for a sample of 151 quasars. Thus the quasar redshifts can be interpreted as primarily of gravitational rather than cosmological origin, and the quasars are placed at moderate distances, 3C48 being within the local group of galaxies. (auth)

18166 BALLOON MEASUREMENTS OF THE FAR-INFRARED BACKGROUND RADIATION. Muehlner, D.; Weiss, R. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 7: No. 2, 326-344(15 Jan 1973).

Measurements in five different passbands in the spectral region below 20 cm^{-1} were made with a liquid-helium-cooled radiometer in two flights at approximately 40-km altitude. The equivalent temperatures were $2.7^{+0.4}_{-0.2}$, 2.8 ± 0.2, 2.8 ± 0.2, ≤ 2.7, ≤ 3.4°K in passbands of 1 to 5.4, 7.8, 7.9, 11.1, and 18.5 cm^{-1}. The results were consistent with a 2.7°K thermal radiation background. Atmospheric radiation of uncertain magnitude dominates the region above 11 cm^{-1}. (auth)

18167 SOME REMARKS ON THE HUBBLE LAW. Popovici, C. (Observatorul Astronomic, Bucharest). Stud. Cercet. Astron.; 17: No. 2, 171-175(1972). (In Rumanian).

The Hubble law is deduced in an elementary manner in the hypothesis of the simple cosmological principle, for a Euclidean space and a constant velocity of the light, giving the expression of the redshift z, taking account not only of the expansion but also of the Einstein gravitational shift. The importance of the time delay of the light propagation on the Hubble law is stressed and the exact formulation of the law is given for the light equation, $r + c \cdot t = 0$. (auth)

18168 NEUTRON STARS IN THE SCALAR–TENSOR THEORY OF GRAVITATION. Yokoi, K. (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1760-1761(Nov 1972).

Distinction among the various theories of gravitation might be possible from the study of superdense objects such as neutron stars. Their mass, radius, and other properties can be determined from the equation of state for the stellar matter and the theory of gravitation. Previous work with the Brans–Dicke scalar–tensor theory has assumed the equation of state for a noninteracting Fermi gas neglecting the effects of nuclear forces. In this work the nuclear forces are taken into account by using the Kodama–Yamada mass formula for compressible nuclei. It is concluded that the difference between the scalar–tensor theory of gravitation and general relativity is rather small in comparison with uncertainties caused by various equations of state. (2 figures) (RWR)

18169 EXACT COSMOLOGICAL SOLUTIONS IN BRANS AND DICKE'S SCALAR—TENSOR THEORY. I. Dehnen, H.; Obregon, O. (Univ., Konstanz, Ger.). Astrophys. Space Sci.; 14: No. 2, 454-459(Dec 1971).

The exact solution is sought for the cosmological equations of Brans and Dicke's scalar–tensor theory when a power law exists between the gravitational constant and the radius of curvature of the Universe. For the space of negative curvature no solution is possible. On the contrary for a closed space the gravitational constant and the radius of curvature increase linearly with respect to the age of the Universe. The parameter ω of the scalar–tensor theory is necessarily negative and can be determined by the present values of the mass-density of the Universe, the Hubble-constant, and the gravitational constant. The solution has no analogy in Einstein's theory with vanishing cosmological constant, even when the deviations from Einstein's values of the solar relativistic effects are small. (auth)

18170 IMPLOSIONS AND EXPLOSIONS IN SUPERMASSIVE OBJECTS. Shaviv, G.; Tauber, G. E. (Tel-Aviv Univ., Israel). Astrophys. Space Sci.; 14: No. 2, 396-398(Dec 1971).

It is shown that for small velocities the time-dependent evolution of massive stars may be described by a series of static models. Those are linked to each other by one continuous time dependent parameter—the relativity effect. The fate of the dynamic system is analyzed by the behavior of the static models. The method is illustrated for general relativistic polytropes. (auth)

18171 FIELD APPROACH TO GRAVITATION AND ITS SIGNIFICANCE IN ASTROPHYSICS. Majernik, V. (Inst. of Physics, Bratislava). Astrophys. Space Sci.; 14: No. 2, 265-285(Dec 1971).

A field modification of classical gravitational theory which is analogous to the classical electrodynamics is proposed. Within its framework it is possible to account for some types of be-

havior of matter occurring under certain extreme physical conditions. Especially, the energy release in quasars and pulsars may be calculated, under some plausible physical assumptions, to obtain values comparable with the observable ones. Several astrophysical effects (e.g., the occurrence of nonthermal radiation in pulsars and quasars, etc.) find reasonable explanations within this field approach to gravitation. (auth)

18172 COSMOLOGICAL TRANSFORMATION. Hafner, H. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17, No. 8, 933-946(1972).

The theory of a new model of the Universe is considered. The derivation of this model is based on four known cosmological principles. The ensemble of the axioms turns out to be coherent and in accordance with either special or general relativity. One of the most noticeable results of the proposed model is the appearance of a selection criterion for the kind of space to be used in cosmology—a hyperbolic (open) one. This space leads to the avoidance of some contradictions which persisted in the frame of the theory based on Robertson–Walker metrics. These contradictions are analyzed and the reason for their appearance is explained. (auth)

18173 THERMAL FUTURE OF THE UNIVERSE. Davies, P. C. W. (King's Coll., London). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 1-5(1973).

The thermal behavior of matter and electromagnetic radiation in the late stages of ever expanding cosmologies is examined. The cooling rate of ions is calculated, and the absorption of radiation discussed, leading to a condition for complete opaqueness. (auth)

Planetary Phenomena

18174 FIELD THEORY. III. Energy spectrum and stationary-orbit elements in central gravitational fields. Gulak, Yu. K. (Poltava State Pedagogical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 36-44(1972). (In Russian).

The field-dynamic equilibrium equation was solved for motion of particles within the limits of a bounded sphere of the effective action of a gravitational field of a central body. A system of stationary orbits exists, the fundamental sign of which is the multiplicity of specific total energy and the square of the moment of the momentum with some constants for the assigned system of a portion of the energy and "quanta" or action. An analogy between the formulas obtained and Bohr's postulates for a microsystem was stressed, the rules of quantization of elliptical orbits and spatial quantization are given. Subsidiary to this were two more "quantum" numbers which completely fixed the position of a stationary orbit in the system, associated with the central body. By way of illustration, confirming the theoretical conclusions, an analysis is given of the planet-asteroid distribution at mean distances from the sun. The postulate which defined the main points of the mechanical phenomena in the planetary and atomic systems suggests that there exists a still more profound analogy than that assumed at the present time. (tr-auth)

18175 DISTRIBUTION AND ISOTOPIC ABUNDANCE OF BIOGENIC ELEMENTS IN LUNAR SAMPLES. Kaplan, I.R. (Univ. of California, Los Angeles). Space Life Sci.; 3: No. 4, 383-403(Oct 1972).

A review of the abundance of six biologically important elements (H, C, N, O, P, and S) demonstrates that they are present in trace amounts only in lunar matter analyzed to date. To the endogenous lunar content, elements are contributed by solar-wind irradiation and meteorite impacts. However, it is not yet possible to determine the relative importance of the three sources. Enrichment of the heavy isotopes, ^{13}C, ^{18}O, ^{34}S suggests that these elements may be lost from the lunar surface by 'hydrogen stripping' (from solar-wind protons) as volatile gases. The general lack of water suggests that organic synthesis could not easily be accomplished in lunar rocks. High-energy irradiation of the lunar surface may result in rapid destruction of organic matter not protected by a silicate matrix. It is apparent from the present data available that the ambient lunar surface could not support metabolism of known microorganisms. (auth)

18176 ATMOSPHERES OF THE EARTH AND THE TERRESTRIAL PLANETS: THEIR ORIGIN AND EVOLUTION. Meadows, A.J. (Univ. of Leicester, Eng.). Phys. Rep.; 5C: No. 4, 197-235(1972).

The stability of the Earth's atmosphere is reviewed, and the importance of the hydrosphere and biosphere in the development of the atmosphere is emphasized. Although the Earth's atmosphere has naturally been investigated in the greatest detail, the atmospheres of other terrestrial planets may have had a simpler developmental history. The atmospheres of the Earth, Venus, and Mars are compared, and it is shown that a consistent model of their evolution can be obtained on the basis of degassing from the solid planet. (auth)

18177 U–Th–Pb SYSTEMATICS IN LUNAR HIGHLAND SAMPLES FROM THE LUNA 20 AND APOLLO 16 MISSIONS. Tera, F.; Wasserburg, G. J. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 17: No. 1, 36-51(Dec 1972).

Luna 20 and Apollo 16 soils which represent two highland sites contain Pb which has $^{206}Pb/^{204}Pb$ of from 53 to 277 and radiogenic $^{207}Pb/^{206}Pb$ of from 0.78 to 0.83. The soils yield very discordant ages which range from 4.91 up to 6.08 AE. A few of the results on soils can be discussed in terms of a simple two-stage model in which the lunar crust is generated by the addition of magmatic material enriched in Pb relative to both U and Th (without U–Th fractionation). The fractionation factor $(Pb/U)_{magma}/(Pb/U)_{source}$ is commonly ~2.5 or more. In no way can the soil model ages give a direct determination of the age of the Moon. The highland anorthosite 60025 gave a Pb concentration of 6.9 ppB and appears distinctly radiogenic with $^{206}Pb/^{204}Pb = 25.4$. The $^{207}Pb–^{206}Pb$ age is 6.64 AE but the U concentration of 0.79 ppB is sufficient to account for the radiogenic Pb. This result is distinctly different from ancient and highly radiogenic initial Pb in 14310, 14053, and 15415. The extent to which various rock types of different ages and undetermined exotic materials contribute unsupported initial Pb to lunar soil is not yet established. The complexity of the Pb–U–Th data on the soils is remarkable in comparison with the simple behavior of the Rb–Sr results. (auth)

18178 Rb–Sr SYSTEMATICS OF LUNA 20 AND APOLLO 16 SAMPLES. Papanastassiou, D. A.; Wasserburg, G. J. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 17: No. 1, 52-63(Dec 1972).

Lunar soils from all missions indicate that an early lunar differentiation process occurred in the interval 4.3 to 4.6 AE and resulted in the formation of a crust rich in K, Rb, U, and Th. An attempt has been made to identify rocks which were formed during this early differentiation event. (auth)

18179 URANIUM–LEAD SYSTEMATICS IN LUNAR BASALTS. Gale, N. H. (Oxford Univ.). Earth Planet. Sci. Lett.; 17: No. 1, 65-78(Dec 1972).

A logical and coherent account of U–Pb systematics is sketched out and its application to lunar basalt data is discussed. It is demonstrated that the concept introduced by Tera and Wasserburg (1972) that initial $^{207}Pb/^{206}Pb$ may provide a new chronometer for early lunar evolution is superfluous, in that it provides no information not also yielded by the well-established concordia diagram. The essential redundancy of the $^{207}Pb/^{206}Pb–^{238}U/^{206}Pb$ diagram vis-a-vis the concordia diagram is also demonstrated. A discussion is given of the extremely limited value, and misleading nature, of the concept of "model age" as ordinarily used. The possibility of deriving an independent formal "age of the Moon" from lunar basalt U–Pb data is discussed, and compared with similar attempts to derive an independent "age of the Earth" from terrestrial oceanic basalts. In both cases it is demonstrated that the validity of the "age of the planetary body" derived is dependent on a strictly two-stage episodic U–Pb evolution. No firm conclusions can yet be drawn from the Apollo 14 U–Pb data about the "age of the Moon." Finally, an analysis is made of Apollo 14 internal isochron and whole rock data, which (although of very high quality) is as yet inadequate to allow completely unambiguous interpretation, although it may be in agreement with a recently published interpretation of Apollo 14 Rb–Sr whole rock data. (auth)

18180 EXTRALUNAR MATERIALS IN APOLLO 16 SOILS AND THE DECAY RATE OF THE EXTRALUNAR FLUX 4.0 GY AGO. Baedecker, P. A.; Chou, C. L.; Sundberg, L. L.; Wasson, J. T. (Univ. of California, Los Angeles). Earth Planet. Sci. Lett.; 17: No. 1, 79-83(Dec 1972).

The concentration of extralunar materials in the Apollo 16 regolith is about 3.5%, about 50% higher than that observed at the Apollo 14 site, and three times higher than values at mare landing sites. The integrated flux of extralunar materials is 2.5 times higher at the Apollo 16 than at the Apollo 14 site. These data support the hypothesis that the flux of extralunar materials decreased rapidly between 4.0 and 3.7 Gy ago, and demonstrate the presence of appreciable unaccreted materials near 1 AU 600 my after the formation of the solar system. Assumed ages of 3.91 and 4.00 Gy for the Apollo 14 and 16 sites yield a half-life of this short-lived population of about 45 ± 15 my. The lunar accretion rate 4.00 Gy ago was about 2.4×10^{-6} g cm^{-2} yr^{-1}, about 700

times greater than the current accretion rate of 3.5×10^{-9} g cm^{-2} yr^{-1}. (auth)

18181 DETECTION OF RADON EMANATION FROM THE CRATER ARISTARCHUS BY THE APOLLO 15 ALPHA PARTICLE SPECTROMETER. Gorenstein, P.; Bjorkholm, P. (American Science and Engineering, Cambridge, MA). Science; 179: No. 4075, 792-794(23 Feb 1973).

The alpha-particle spectrometer aboard the Apollo 15 command/service module was designed to detect alpha particles from radon decay and to locate regions with unusual activity on the moon. A significant increase in ^{222}Ra activity was detected from a region containing the crater Aristarchus. The result is interpreted as probably indicating internal activity at the site. By analogy with terrestrial processes, increased radon emanation may be associated with the emission of other volatiles. (auth)

18182 LUNAR SURFACE RADIOACTIVITY: PRELIMINARY RESULTS OF THE APOLLO 15 AND APOLLO 16 GAMMA-RAY SPECTROMETER EXPERIMENTS. Metzger, A. E. (California Inst. of Tech., Pasadena); Trombka, J. I.; Peterson, L. E.; Reedy, R. C.; Arnold, J. R. Science; 179: No. 4075, 800-803 (23 Feb 1973).

Gamma-ray spectrometers on the Apollo 15 and Apollo 16 missions were used to map the Moon's radioactivity over 20% of its surface. The highest levels of natural radioactivity were found in Mare Imbrium and Oceanus Procellarum with contrastingly lower enhancements in the eastern maria. The ratio of potassium to uranium was higher on the far side than on the near side, although it was everywhere lower than commonly found on the Earth. (auth)

18183 ACCRETION MECHANISM FOR THE FORMATION OF A PROTOPLANETARY DISC. Aust, C.; Woolfson, M. M. (York Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 7-13 (1973).

The accretion mechanism for the formation of a protoplanetary disc as proposed by Lyttleton has been examined. Recent observational and theoretical results indicate that the conditions originally put forward regarding the temperature and state of the cloud and its velocity relative to the Sun are implausible. It is shown that a cloud of the original dimensions would be gravitationally distorted and eventually disrupted by the approach of the Sun. Encounters between the Sun and larger and/or denser clouds in which the degree of distortion is greatly reduced have been investigated over ranges of cloud parameter values. It is found that amounts of material satisfying the mass and angular momentum requirements of a protoplanetary disc may still be captured by the accretion process. The similarity between this theory and the capture theory for planetary formation is suggested. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 18141.

18184 (N-72-28353) OGO-4 OBSERVATIONS OF THE 6300-A NIGHT AIRGLOW FROM 40° N TO 40° S: A SET OF 19 COLOR MAPS. Reed, E. I.; Blamont, J. E. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). May 1972. 27p. (NASA-TM-X-65954). NTIS.

Data for the 6300-A line of atomic oxygen from the main-body airglow photometer on the OGO-D satellite are summarized in a set of 19 maps for various local times at night between Aug. 30, 1967 and January 10, 1968. (auth)

18185 (NP-19626) OBSERVATIONS SUGGESTING WEAK PITCH ANGLE DIFFUSION OF PROTONS. Scientific/Technical Report No. 41. Berg, L. E.; Soeraas, Finn (Bergen Univ. (Norway). Dept. of Physics). May 1972. 22p. Dep. NTIS (U. S. Sales Only).

A pronounced longitude variation in the intensity of locally mirroring protons above 100 keV in the L range 3.5 to 5 at low altitudes is observed. The observations can be accounted for by a steady-state pitch-angle diffusion process. The pitch-angle diffusion coefficient for protons mirroring near the loss cone at L = 4 is found to be around 10^{-6} s^{-1}. The data support earlier observations of a longitudinal variation in high-latitude phenomena. (auth)

18186 (NP-19639) 6300A (OI) AIRGLOW AT HIGHER MID-LATITUDES DURING SOLAR MAXIMUM. Nichol, D. G. (Tasmania Univ., Hobart (Australia)). Feb 1971. 262p. Dep. NTIS (U. S. Sales Only).

Thesis.

A description of the work carried out at Hobart during the 1968 - 1970 solar/auroral maximum on the airglow emission of atomic oxygen, particularly the red 6300-A line, is given. It is found that estimates of dissociative recombination based on generally accepted atmospheric models are too low within the midlatitude ionospheric trough. It is shown how a partial departure from diffusive equilibrium within the trough can largely explain the observed intensities and partly explain the formation of the trough; the remainder of the airglow and the lack of maintenance of the trough region are explained by conjugate-point photoelectrons. Some contribution, certainly on disturbed days, to the soft electron flux comes from the precipitation of trapped very-low-energy Van Allen electrons. It is shown how these processes can cause the trough to move in the way it does. The influence of neutral-atmosphere winds on 6300-A airglow is shown. They explain the midnight summer enhancement found at Hobart and low latitudes and partially explain the pre-dawn enhancement. The remainder of the PDE appears to be due to conjugate-point photoelectrons and a small contribution from downward diffusing exospheric electrons. (JCW)

18187 REPORT ON BALLOON FLIGHTS FROM NORTHERN NORWAY AND ICELAND 1971. Trefall, H.; Brown, R. R. (Univ. of Bergen, Norway). SPARMO Bull.; 5: No. 1, 17-33(Aug 1972).

A short report is given of the balloon survey carried out in the summer of 1971 for the purpose of studying auroral-zone electron precipitation events with launchings from four stations in northern Norway, two in Iceland, and associated ground-based magnetic and vlf recordings. Experimental procedures and organizations are briefly described, and lists of flights with summaries of recordings are given. (France)

18188 FEATURES OF THE MORNING MAXIMUM IN DAILY AURORAL ABSORPTION EVENTS. Shumilov, O. I.; Fedoseev, V. I. Uch. Zap. Leningrad. Gos. Univ., No. 366, Ser. Fiz. Geol. Nauk; No. 22, 122-130(1972). (In Russian).

A substorm begins in the midnight sector of the auroral zone and then spreads in all directions. A morning maximum in auroral absorption is generally observed. The relation between this maximum and the ionospheric conditions in the morning hours and the parameters of the system of S_D variations is discussed. (KSW)

18189 ELECTRON PRODUCTION, RECOMBINATION, AND HEATING IN THE F REGION OF THE IONOSPHERE. Swartz, W. E. University Park, PA; Pennsylvania State Univ. (1972). 212p. University Microfilms Order No. 72-33,210.

Thesis (Ph. D.).

Photoionization rates have been calculated from recent solar euv flux measurements and are compared with the electron-ion recombination rates estimated from electron density profiles and current reaction rates. These photoionization rates also provided the first step in calculating the photoelectron heating rates of the ambient electrons, which are compared with the cooling rates deduced from ion and electron temperature measurements at Arecibo. The effects of changes in the assumed neutral models, in the rate coefficients, and in the temperature measurements are discussed. Particular attention was paid to the vertical energy transport mechanisms involving electrons in the F1 region, and it is shown that the energy transport effects are generally negligible compared with local energy transfer terms. Divergence of the photoelectron fluxes and conduction fluxes becomes important above 250 km. Comparisons of the profiles of energy input and loss with similar profiles of ion production and recombination suggest that the solar euv fluxes have been underestimated. These comparisons also imply lower molecular neutral densities in winter than in summer. A useful function relating the mean energy per photoelectron given to the ambient electrons and the electron-neutral density ratio is presented as a single curve which is valid for a wide range of conditions in the F region below altitudes where photoelectron escape is an important factor. (Diss. Abstr. Int., B)

18190 FORMATION THEORY OF SPORADIC E BY TIDAL WIND SYSTEMS. Taur, R. R. Logan, UT; Utah State Univ. (1972). 119p. University Microfilms Order No. 73-920.

Thesis (Ph. D.).

Analysis of large samples of sporadic E data show that sporadic E is more likely to occur in the late afternoon than in the middle of the day, even though the background ionization of the E region is less in the afternoon. This situation produces E_s patches in the afternoon that are less intense than during midday but there are more of them. There is also a smaller occurrence peak in the summer morning. This asymmetric occurrence feature of E_s must be attributed to the wind since the variation is different from the variation of the normal E region. Theoretical electron-density profiles have been calculated with a daytime Chapman-like E region ionization and with tidal wind components extracted from the rocket data by Woodrum. The diurnal, semidiurnal, and prevailing winds (90 to 135 km) are mated to the winds derived from meteor radar measurements (80 to 100 km) in order to get the seasonal variations of the tidal wind components. Comparisons of the summer, fall, and winter theoretical electron density profiles with the occurrence features of sporadic E, i.e., occurrence frequency, fbE_s values, and height of E_s, show an interesting correlation. It is tentatively concluded that the tidal wind system while too weak to form moderate or intense E_s, nevertheless creates a small bulge in the electron density profile. This bulge then increases the probability that the random component of the ionospheric wind can go ahead and produce sporadic E. The probability that the shear of the random wind will be at the proper altitude to add to the tidal shear is approximately the same as the probability of measuring sporadic E. (Diss. Abstr. Int., B)

18191 EFFECT OF X RAYS FROM SCORPIO-XR-1 UPON THE LOWER IONOSPHERE. Mitra, S. N. J. Inst. Telecommun. Eng.; 17: No. 11, 421-428(1971).

One year's data of the received field strength at Delhi of long-wave transmissions of Radio Tashkent (164 kHz) have been analyzed. An attempt was made to correlate the transit times of Sco-XR-1 with changes in the field intensity in the received long-wave field. Various statistical computations were made to obtain the clear effect, if any, of the x-rays from Sco-XR-1 upon such long-wave propagation. The effect of some of the x-ray flares from high-altitude balloons and OSO satellites was studied with a view to finding out any correlation between these flares and the corresponding long-wave field. It is concluded from the various analyses presented that the x-rays from Sco-XR-1 do not appear to have any effect on the propagation of a long-wave transmission through the Earth's lower ionosphere. (Indian Sci. Abstr.)

18192 DAILY VARIATION OF E-REGION DRIFTS AT THE DIP EQUATOR DURING 1968-69. Misra, R. K.; Rastogi, R. G. (Physics Research Lab., Ahmedabad, India). J. Inst. Telecommun. Eng.; 17: No. 11, 406-407(1971).

The daily variation of E-region horizontal drift is presented for an equatorial station, Thumba (0.6°S dip). The daytime drift is found to be predominantly westward and the nighttime drift predominantly eastward. The magnitude of nighttime drift in the E region is of the same order as the F-region nighttime drift at Thumba. The times of morning and evening reversals in the E

region are shown to be variable with the season unlike that of the F region. The morning reversal of drift in E region occurs earliest in the summer and the evening reversal is latest in the equinoxes. (Indian Sci. Abstr.)

18193 DAILY AND SEASONAL CHANGES OF CONDITIONS FOR APPEARANCE OF THE F1 LAYER OVER CENTRAL ASIA DURING THE IQSY. Alimov, O.; Kurbanov, A. Dokl. Akad. Nauk Tadzh. SSR; 15: No. 9, 19-22(1972). (In Russian).

During the period of minimum solar activity an increased development in the F1 layer was observed to be nonuniform with respect to latitude. The conditions surrounding the appearance of the F1 layer in the ionosphere were studied at stations located at Dushanbe, Tashkent, and Ashkhabad during the IQSY (1964-5), winter, summer, and at the equinox. Coefficients of asymmetry at the three stations ranged from −0.52 to 0.00, the larger negative values being peculiar to Dushanbe. In general, the observation of a clearly defined F1 layer varied from month to month, and from season to season. (KSW)

18194 EXCITATION OF O_2 HERZBERG BANDS IN THE NIGHTGLOW. Srivastava, R. D. (Univ. of Allahabad, India); Shukla, R. V.; Srivastava, A. N. Astrophys. Space Sci.; 14: No. 2, 317-322(Dec 1971).

The excitation mechanism for O_2 Herzberg bands as given by Young and Black (1966) is examined. It is found that O_2 Herzberg bands are heavily quenched by N atoms, while (0,0) and (0,1) atmospheric bands are quenched mainly by CO, NO, O_2, and N_2, NO, O_2, respectively. The emission of Herzberg bands is found to arise from two layers centered at 80 and 100 km. The rate coefficients of a number of quenching reactions involving atmospheric gases are obtained theoretically. (auth)

18195 EQUATORIAL SPORADIC E AND CROSS-FIELD INSTABILITY. Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sect. A; 76: No. 5, 181-194(Nov 1972).

The occurrence of sporadic E at an equatorial station during magnetically quiet daytime conditions corresponds almost exactly to the time during which the horizontal component of the Earth's magnetic field is above the mean nighttime level. Any large decrease of H below the nighttime level is accompanied by the disappearance of equatorial $E_s - q$ reflections precisely for the period when the value of H remains below its nighttime level. Such disappearance of $E_s - q$ can be attributed to the reversal of the current equal to, or greater than, the normal eastward equatorial electrojet current. During magnetically disturbed conditions, however, the depressions in H are not always accompanied by the disappearance of $E_s - q$. Whenever the normal-E and sporadic-E reflections can be resolved on the equatorial ionograms, the minimum virtual height of the normal E is seen to be clearly greater than that of the sporadic-E layer. The creation of E-region irregularities at equatorial latitudes giving the appearance of an $E_s - q$ layer in daytime ionograms is suggested to be due to cross-field (plasma gradient) instability. The horizontal magnetic field and the upward Hall polarization (electric) field produce irregularities in the lower E region where the rate of increase of ambient electron density is large and directed upward. A temporary reversal of the electrojet current indicated by a decrease in H below the nighttime level and the disappearance of $E_s - q$ are due to the temporary reversal of the vertical Hall polarization field making it downward instead of upward which being opposite to the direction of the gradient of plasma density inhibits the cross-field instabilities. 27 references. (auth)

18196 MESOSPHERIC MODELS AND RELATED EXPERIMENTS. Proceedings of the fourth ESRIN−ESLAB symposium held in Frascati, Italy, July 6−10, 1970. Fiocco, G. (ed.). Astrophysics and Space Science Library. Volume 25. New York; Springer-Verlag New York Inc. (1971). 306p. (CONF-700729−). $26.80.

From 4th Symposium on Mesospheric Models and Related Experiments; Frascati, Italy (6 Jul 1970).

Thirty papers were presented at the symposium in Frascati, Italy, July 6−10, 1970, relating the mesospheric structure and composition to theoretical work on atmospheric models and atomic and molecular processes. Photochemical models of the mesosphere were discussed; current models are still patterned after the original work by Bates and Micolet, but introduce simple transport processes and more detailed knowledge of the photochemistry of major species and of the solar flux. Stratospheric and mesospheric dynamics, including tides and gravity waves, were reviewed, and the attempt to consolidate photochemistry and dynamics on a global scale was emphasized. Particular attention was devoted to assessing the role of water vapor. Processes relating to dissociation, trapping, polymerization, and clustering were considered, with special reference to their effect on electron density. Validity of experimental models was confirmed from rocket probes and mass spectrometer results and on airglow measurements. Solar radiation and molecular spectra correlated to the mesosphere were discussed. (JCW)

18197 GEOMAGNETIC CONTROL OVER EVOLUTION OF F2-LAYER AT SUNRISE. Nestorov, G. T. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 8, 1037-1040(1972).

The ionospheric F2 layer was observed from 1966 to 1971 at a fixed frequency of 7.67 MHz from Sofia. The appearance of the layer after sunrise is dependent on the season, solar activity, and on conditions of emergence of mhd and gravitational waves within the layer during periods of geomagnetic storms and anomalies. The evolution of the F2 layer after sunrise up to an isoelectronic level $N = 7.10^5$ cm^{-3} is correlated with the state of the geomagnetic field. Anomalies in the evolution of the F2 layer at sunrise show that dynamic processes play an essential role in ionization balance. The role increases in the presence of geomagnetic anomalies, suggesting the source of the disturbances; the bombarding by energetic particles and the effect of mhd waves. Both processes heat the region, increase the loss of free electrons, intensify electron transport by electromagnetic forces. The changes in the difference between the electronic and ionic temperature intensify ambipolar diffusion. The nonmagnetic disturbances appear mostly as a result of the changes in the composition and temperature of the neutral component. (JCW)

18198 CONTRIBUTION OF HARD SOLAR X-RAY RADIATION TO D-REGION IONIZATION. Nestorov, G. T.; Apostolov, E. M. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 10, 1343-1346(1972).

An attempt was made to detect the relationship of the absorption measured by the A3 method in the Sofia Ionospheric Observatory of the equivalent frequency $f_i \approx 2$ MHz with the x radiation below 8 and below 20 A. The data on absorption and no radiation were taken for 5-hour intervals for every day in 1970 in typical conditions of mean solar activity. A general assessment of the ionization of the D region is made. At high solar activity, hard x radiation dominates. At mean activity, hard x radiation competes with Lyman-α radiation ($\lambda = 1216$ A), being determinant at the upper end of the relative sunspot range while Lyman-α is the determinant at the lower end. At low solar activity, the ionization state of the D region is conditioned first by Lyman-α, next by hard x radiation, and third, by cosmic radiation. (JCW)

18199 CHARGE EXCHANGE PROCESSES OF ENERGETIC PROTONS IN THE HIGHER ATMOSPHERE. Schmidt, J. Atomkernenergie; 20: No. 3, 213(Dec 1972). (In German).

When hitting the outer atmosphere at polar latitudes, protons in the eV or keV range cause charge exchange processes which produce a three-component particle stream consisting of H^+, H^0, and H^-. Relative composition of the stream depends on conditions of the atmospheric boundary, kinetic energy of the particles, and the pitch angle. Computations, based on a suitable model, allow predictions about processes caused by proton and alpha beams of solar flares. (H.B.G.)

18200 PROTONS AND ALPHA PARTICLES IN PCA EVENTS. Witte, M.; Hempe, H. Atomkernenergie; 20: No. 3, 191(Dec 1972). (In German).

During two solar flares in February 1969 and January 1971, respectively, polar-cap absorption was measured with two rockets each. The rockets carried scintillation telescopes for the determination of the proton−alpha ratio within an energy range of 20 to 130 MeV. For the first flare, apparatus and results were described in several other reports. For the second flare, data are still in the process of evaluation. (HBG)

18201 MEASUREMENTS OF MeV ELECTRONS IN RECOVERY PHASE OF POLAR MAGNETIC PARTICLE STORMS. Boehm, J. Atomkernenergie; 20: No. 3, 211-212(Dec 1972). (In German).

An electron spectrometer was developed for energies from 0.55 to 3.4 MeV. On March 6, 1970, the instrument was shot with a rocket to an altitude of 217 km at Andenes, Norway. Due to the fact that the nose-cone cover failed to separate, the measured energies were reduced to a range between 2.5 and 3.5 MeV. The results of high-energy electron-, magnetometer-, and riometer-measurements in the polar region could be explained through an expansion of the terrestrial magnetic field. This process would also explain those phenomena that occur during the recovery phase of polar magnetic storms. (HBG)

18202 RESPONSE OF THE IONOSPHERE TO ION-ACOUSTIC WAVE SPECTRA EMITTED BY A LOCALIZED PULSED SOURCE IN SPACE. Odoux, J. M. (Centre National d'Etudes des Telecommunications, Lannion, France). Ann. Geophys.; 28: No. 2, 287-300(Apr 1972). (In French).

The theory of vlf ion-acoustic waves (Poeverlein, 1968) is adapted to periods ranging from two hours to one day in the case of the lower F layer, only the motion of the plasma (without the associated motion of the neutral gas) being taken into account. The introduction of ion–neutral collisions and a vertical temperature gradient in the calculations led to the establishment of two modes (upward and downward modes) associated with the production–recombination process for the case in which the natural ionic winds can be neglected. A localized pulse source is hypothesized; the existence of a nonzero response for upward and downward wave spectra seems to be closely associated with the relative values of the ion density and temperature gradients. It is shown how such a source could lead to large variations in the ion velocity in the F2 region. The results obtained are used to explain some of the properties of magnetic storms. Certain classical oscillations in the ionic velocities observed with incoherent scattering probes at Saint–Santin–Nancay during magnetic storms are explained by the theory. (FR)

18203 REFRACTION OF WHISTLER-MODE WAVES BY LARGE-SCALE GRADIENTS IN THE MIDDLE-LATITUDE IONOSPHERE. James, H. G. (CNRS, Saint-Maur-des-Fosses, France). Ann. Geophys.; 28: No. 2, 331-339(Apr 1972).

A ray-tracing method was developed to predict the direction of propagation of vlf waves in the topside ionosphere at middle latitudes, refraction by large gradients in the electron density being taken into account. An electron-density-distribution model was developed from data obtained with ionospheric sounders on the ground and also from topside sounder satellites. The accuracy of the method was confirmed by comparing estimated wave–normal directions at an altitude of 750 km with those observed by the FR-1 satellite. The method was used to estimate the distribution of the vlf wave–normal directions at the base of the protonosphere during certain nights in March 1966. A remarkable correlation was found between the rate of occurrence of whistlers and the extent to which the vlf wave normals approach the direction of the Earth magnetic field. This result establishes the importance of large gradients in determining the rate of occurrence of whistlers. (FR)

18204 D-REGION PARAMETERS FROM THE EXTRAORDINARY COMPONENT OF PARTIAL REFLECTIONS. Beer, T. (Univ. of Western Ontario, London). Ann. Geophys.; 28: No. 2, 341-347(Apr 1972).

Provided that the height variation of electron-density fluctuations, ΔN, is known, it is then possible to obtain electron-density profiles by using only one component of the partial reflections from the lower ionosphere (50 to 90 km). The extraordinary component provides more accurate results than does the ordinary component. However, if the profile of ΔN fluctuations is not known, then the same theory can be used to find it, provided that N is known. It appears that the profile of ΔN fluctuations has the same upward amplification as internal gravity waves. (FR)

18205 AURORAL MORPHOLOGY. Deehr, C. S.; Egeland, A. (Norske Institutt for Kosmisk Fysikk, Oslo). Ann. Geophys.; 28: No. 2, 415-425(Apr 1972).

Sophisticated experiments involving satellites, rockets, balloons, and aircraft have given many new aspects to auroral morphology. A composite picture of the occurrence and extent of electron auroral forms is discussed. The all-sky camera data can be regarded as the locus of 5- to 15-keV electron precipitation. The average position of auroral electron precipitation for different levels of magnetic activity is discussed. It is argued that different sources of auroral electrons exist and that locally accelerated particles may be important poleward of the 40-keV trapping boundary. Even with horseshoe-shaped precipitation zones, the auroral oval may be continuous because of quasi-trapped radiation, originating with the substorm, arising from longitudinal drifts along closed field lines around the oval. Single events are studied in the frame of reference of the auroral substorm and their relation to magnetospheric processes. It is shown that the brightening of the aurora at the beginning of the substorm occurs poleward of the trapping boundary and does not involve protons. An important discontinuity in the night-time auroral precipitation pattern near the >40-keV electron trapping boundary is found. It is suggested that this boundary may be a good reference line. (FR)

18206 VARIATIONS OF THE AURORAL ELECTRON ENERGY SPECTRA DURING SUBSTORMS. Ivanov, V. E.; Starkov, G. V. Ann. Geophys.; 28: No. 2, 427-431(Apr 1972).

The intensity distribution was measured for different types of aurorae as a function of altitude. It is assumed that the spectrum of the precipitating electrons obeys an exponential law, the effective energy of the spectrum being fitted to the vertical profiles observed. The variations in the effective life during the development of individual forms or a substorm were studied. The maximum rigidity occurs just before break-up, the effective energy being 4 keV. After the break-up phase, the spectrum becomes softer with $E_{eff} = 0.5$ keV. (FR)

18207 PRECIPITATION PATTERNS IN THE ARCTIC IONOSPHERE DETERMINED FROM AIRBORNE OBSERVATIONS. Buchau, J.; Gassmann, G. J.; Pike, C. P.; Wagner, R. A.; Whalen, J. A. (Air Force Cambridge Research Labs., Bedford, MA). Ann. Geophys.; 28: No. 2, 443-453(Apr 1972).

A high-speed aircraft instrumented with an ionospheric sounder, photometers, and all-sky cameras provides an efficient observatory for determining large-scale auroral precipitation patterns since it can move in a coordinate system fixed to the auroral oval. Accelerated local-time flights permit investigations of the oval in its entirety. Constant LT flights permitted the extended observation of selected oval sectors. The following results were obtained using these techniques: the identification of three distinct precipitation zones in the noon sector whose particle energy decreases from south to north (southernmost, a zone of D-region ionization, next a band of E-region ionization, northernmost a band in which the visible aurora, auroral, E_s, the F-layer irregularities, and the 6300-A emission are closely associated); the identification of an auroral E layer in all time sectors of the auroral oval during quiet magnetic conditions. All-sky pictures demonstrate that the auroral oval is continuous when $\Sigma K_p > 10$, but that gaps occur for $\Sigma K_p < 10$ (these gaps are bridged by subvisual band of auroral emissions). The day sector of the oval is shown to be co-located with a band of enhanced 6300-A emission and a band of F-layer irregularities resulting from the precipitation of cusp particles. (FR)

18208 ROCKET MEASUREMENTS OF LOW ENERGY ELECTRONS AND OPTICAL EMISSIONS IN THE DAYGLOW AND AURORA. Feldman, P. D. (Johns Hopkins Univ., Baltimore). Ann. Geophys.; 28: No. 2, 489-495(Apr 1972).

The effect of low-energy electrons in both the day airglow and the aurora was studied in a series of rocket experiments in which both the differential electron flux and the principal optical emissions were measured simultaneously. (FR)

18209 STUDY OF DISTURBANCES OBSERVED ON MARCH 8, 1970 IN THE MIDNIGHT SECTOR. Cambou, F. (Univ., Toulouse); Gasset, G.; Saint-Marc, A.; (and others). Ann. Geophys.; 28: No. 2, 465-472(Apr 1972). (In French).

The dynamic behavior of auroral disturbances during the 8th of March 1970 storm is investigated in the midnight sector from simultaneous records of magnetometer, photometer, camera, riometer, spectrograph, and x-ray balloon detectors. Three well-defined substorms appear. During the second one, the auroral precipitation is strongly and synchronously modulated over large regions. During the third substorm, the precipitation zone widens toward south, and the auroral disturbances show a maximum intensity at anomalously low latitudes. (FR)

Magnetospheric Phenomena

Refer also to abstract 18185.

18210 (N–72-28322) HIGH-ENERGY ELECTRON SPIKES AT HIGH LATITUDES. Brown, J. W.; Stone, E. C. (California Inst. of Tech., Pasadena). Jan 1972. Contract NAS5-3095. 41p. (NASA-CR–122512; SRL–72-1). NTIS.

Over 750 spikes of precipitating electrons with E > or = 425 keV were observed aboard the low altitude polar orbiter OGO-D between July 30, and December 31, 1967. The spikes may be divided into three distinct populations, depending on whether they occur at latitudes below, at, or above the local limit of trapping. (auth)

18211 (TRITA–EP–71-8) STATIONARY, ADIABATIC PLASMA FLOW IN THE MAGNETOSPHERE. Karlson, E. T. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). May 1971. 25p. INIS.

It is pointed out that as a result of the existence of forbidden regions, and of inertia effects, the MHD equations are not adequate for the description of the flow. Therefore, the energy distribution of the particles is simulated by two groups of particles with different energy. In the first part of this work, the flow in the magnetosphere is "self-consistent" in the sense that there is no exchange of charge between the magnetosphere and the ionosphere. It is shown that if the two groups are taken

to represent a Maxwellian distribution of particle energies in the plasma sheet, a sharp inner edge of the plasma sheet will result. However, in this case there will be no flow inside this, and the interpretation of the plasmapause as the outermost closed streamline cannot be upheld. If one takes into account that the plasma in the plasma sheet is mixed with the low energy plasma of the polar wind, it becomes possible to identify the forbidden region for the high energy plasma with the inner edge of the plasma sheet, and the forbidden region of the low energy plasma with the plasmapause. In the second part, the interaction of magnetospheric flow with the ionosphere is taken into account. It is pointed out that the "self-consistent" solution above solves this problem also, for one extreme case, namely when there are longitudinal electric fields, and no field-aligned currents. In the other extreme, when the field lines are equipotentials, field-aligned currents must flow, and the solution must be found by an iterative process. It is shown that a modified form of the previous solution is a convenient starting point for such a process. (auth)

18212 ANGULAR DISTRIBUTION OF PARTICLES FROM DATA OF THE SATELLITE "KOSMOS-219". Zubareva, L.V.; Savun, O.I.; Shavrin, P.I.; Tsaplin, V.S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 366-367(1972). (In Russian).

The angular distribution of particles was measured during segments of the orbit of the satellite "Kosmos-219," which possessed an apogee of 1726 km and a perigee of 230 km and an inclination to the equatorial plane of 49°. The approximation for pitch-angle distribution of entrapped particles at the altitudes of the satellite was of the form $\sin^m\Theta$, where m was 4 to 5. (1 figure) (KSW)

18213 PITCH-ANGLE SCATTERING INTO LOSS CONE BY CYCLOTRON RESONANCE. Viswanathan, K. S.; Revathy, K. (Kerala Univ., Trivandrum, India). Proc. Indian Acad. Sci., Sect. A; 76: No. 5, 195-206(Nov 1972).

Whistler-mode wave propagation in the magnetosphere has the required frequency to cause cyclotron resonance with electrons gyrating about a line of force. As a result of the cyclotron resonance by the whistler mode, waves could exchange energy with particles and scatter them into the loss cone. The interaction between a single wave propagating along a line of force and the particles gyrating about the line is studied. Then the wave–particle interaction between the particles and a disturbance, analyzed into a spectrum of waves and the consequent diffusion of the particles in the velocity space, is studied, or more generally, the diffusion of particles into the loss cone. (JCW)

18214 SOME PECULIARITIES OF THE DEVELOPMENT OF THE MAGNETIC STORM ON MARCH 5–10, 1970. Pudovkin, M. I. (Leningrad State Univ.); Raspopov, O. M.; Leontev, S. V.; Troitskaya, V. A. Ann. Geophys.; 28: No. 2, 455-463(Apr 1972).

Comparisons of solar flares and geomagnetic disturbances demonstrated that only solar flares occurring in regions with magnetic fields orientated towards the south have a geophysical effect. The intensity of the dc electric fields in the magnetosphere was estimated from the data obtained from the dynamic spectra of Pi2. It was found to be 5.10^4 emu, which is nearly two orders of magnitude greater than that normally observed. Some parameters concerning the solar wind were obtained; velocity of wind = 1100 km/sec; concentration n = 15 cm^{-3}, intensity of the southward component of the interplanetary magnetic field $B_z = 20\gamma$. It is demonstrated that the principal peculiarities of the storm of March 8, 1970 were due to the anomalous values of the electrodynamic parameters of the solar wind. The dynamic gas parameters are in the usual range. The auroral plasma parameters are estimated. It is shown that the energy of the particles is in the usual range, while the concentration is between one and two orders of magnitude higher than that normally observed. Analysis of Pc4 geomagnetic pulsations demonstrated that the density of the cold magnetospheric plasma was between 5 and 8 times greater than that normally observed. (FR)

18215 TRANSEQUATORIAL PROPAGATION OF DECAMETER WAVES OUTSIDE THE GREAT CIRCLE. PART 2. APPLICATION TO THE STUDY OF IONOSPHERIC IRREGULARITIES BY SCATTERING. Crochet, M. (Univ., Paris). Ann. Geophys.; 28: No. 2, 381-388(Apr 1972). (In French).

A method is proposed for measuring certain equatorial irregularities in the F layer at night using results obtained on transequatorial propagation outside the great circle. Investigations at different frequencies in a direction in which the effects of the longitudinal dimensions of the irregularities do not intervene led to the assigning of mean transverse dimensions of about 15 meters to these irregularities. Azimuthal studies enabled the anisotropy of the irregularities to be measured and the mean longitudinal dimension to be determined (150 meters). The modulation in the electronic density can also be determined by this method, but the difficulties encountered in defining the scattering volume in long distance experiments render the results inexact. A similar kind of investigation using line of sight reflection from the equatorial F layer is suggested as a substitute. (FR)

18216 RESULTS OF THE AZUR EXPERIMENTS ON MEASUREMENTS OF LOW-ENERGY PROTONS. Moritz, J.; Lammers, E. Atomkernenergie; 20: No. 3, 205-207(Dec 1972). (In German).

The first German research satellite project, AZUR, included the measurement of low-energy protons in the range from 0.25 to 1.65 MeV. In the inner radiation belt, the proton intensity was determined at various locations and was depicted schematically. In the outer radiation belt, distribution of protons was unstable because of both magnetic disturbances and solar contributions. Underneath the radiation belt existed a proton population of less than 1 MeV that grew denser around the geomagnetic equator and which was independent of altitude. (HBG)

18217 PROTONS AND ALPHA PARTICLES IN THE ENERGY REGION 5 TO 50 MeV/N AT MARGIN OF RADIATION BELT IN EQUATORIAL LATITUDES. Fischer, H.; Boehm, J.; Auschrat, V. W.; Schmieder, D. Atomkernenergie; 20: No. 3, 208-210 (Dec 1972). (In German).

The German–French satellite DIAL had an apogee of 1645 km and a perigee of 311 km. The orbital plane deviated from the equatorial plane by 5.4°. The time for one revolution was 105 min, and the lifetime of the satellite amounted to 70 days. On March 10, 1970 the rocket was fired from Kouron, French Guiana. Both proton and alpha particles were measured by a telescope with two semiconductor detectors. By means of a comprehensive computer program, the pitch-angle distribution of protons was determined for the equatorial plane. Other observations are still being evaluated. (HBG)

18218 MEASUREMENT OF THE CIRCULATION VELOCITY OF A MAGNETOSPHERIC PLASMA USING A QUADRUPOLAR PROBE IN THE LOWER HYBRID FREQUENCY REGION. Pottelette, R. (CNRS, Saint-Maur-des-Fosses, France). Ann. Geophys.; 28: No. 2, 257-286(Apr 1972). (In French).

An attempt was made to measure the circulation velocity of the magnetospheric plasma using a quadrupolar probe mounted on a spacecraft. It is assumed that the probe lies in a plane perpendicular to the Earth magnetic field and that its transfer impedance is measured as a function of frequency in the region of the lower-hybrid-resonance frequency for different orientations in this plane. It is possible to determine the component of the plasma velocity perpendicular to the magnetic field with respect to the probe; this can be accomplished without having to determine the constitutive parameters of the plasma. (FR)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 17794, 18993, and 19025.

18219 SURFACE AND VACUUM PHYSICS INDEX. Vol. 7, No. 12, 1972. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie–Dokumentation (1972). 56p.

18220 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 7, No. 11, 1972. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 78p.

18221 ELECTRON-IMPACT VIBRATIONAL EXCITATION CROSS SECTIONS FOR MOLECULAR NITROGEN. Polak, L. S.; Slovetskii, D. I. (Inst. of Petrochemical Synthesis, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 575-576(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 645-646 (1972).

The excitation cross sections for the $V^1 = 1$ to 8 vibrational levels of N_2 for electrons of energy 1.7 to 4.0 eV, have a fine resonance structure and an angular distribution indicative of the formation of an unstable negative N_2^- ion. The absolute value of the cross section at 2.3 eV is estimated to be 5.0×10^{-16} cm^2.

Atomic and Molecular Properties

Refer also to abstracts 18246, 18258, 18524, 18525, 18537, 18724, 18753, 18814, 19024, and 19055.

18222 RADIAL-ANGULAR FACTORIZED HYDROGEN ATOM. Cunningham, M. J. (National Water and Soil Conservation Organisation, Wellington, New Zealand). pp 442-52 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The selection rule on hydrogenic radial integrals discovered by Pasternack and Sternheimer has stimulated several attempts to explain it group-theoretically. Some of the difficulties encountered when one uses the "natural" group scheme for the H atom are circumvented by considering the H atom factorized into its radial (O(2,1)) and angular (O(3)) parts, according to the scheme $O(4,2) \supset O(3) \times O(2,1)$. In this case the true radial wave functions of the variable r/n transform according to a representation of the O(2,1) group, and it is shown that the quantity $r^k D_{n/n+q}$ for all positive and negative integers k, where D_a is a dilatation operator defined by $D_a f(x) = f(ax)$, is proportional to the q^{th} component of a tensor. The Pasternack and Sternheimer selection rule follows naturally, and calculation of the appropriate Clebsch–Gordan coefficients allows matrix elements to be calculated. (RWR)

18223 MEASUREMENT OF L AND HIGHER SHELLS PHOTOELECTRIC CROSS SECTIONS IN HEAVY ELEMENTS AT 32.88 keV. Allawadhi, K.L.; Mohanjit, Singh; Sood, B. S. (Punjabi Univ., Patiala, India). Curr. Sci. (India); 42: No. 3, 86-87(5 Feb 1973).

The L-shell photoelectric cross sections for 32.88-keV protons in W, Au, Pb, and U were measured; in addition, the total absorption cross section in Pb was measured at this energy to get information about the photoelectric absorption in M and higher shells of Pb. The method of measurement consisted of irradiating two targets of similar dimensions simultaneously. Materials were chosen such that the L-shell fluorescent x ray from one had almost the same energy as that of the K-shell fluorescent x ray from the other. Comparison of the intensities of the emitted x rays and knowledge of K-shell photoelectric cross sections yielded information about L-shell photoelectric cross sections. (1 table). (RWR)

18224 BINDING ENERGIES FOR CLUSTERS OF ATOMIC-TRIPLET HYDROGEN. Etters, R. D. (Colorado State Univ., Fort Collins). Phys. Lett.; 42A: No. 6, 439-441(15 Jan 1973).

An absolute lower bound energy for small clusters of $^3\Sigma_u^+$ hydrogen and deuterium atoms is determined. No bound states are possible for clusters containing fewer than 9 atoms of hydrogen or fewer than 5 atoms of deuterium. A discussion concerning the possibility of a bound state for the bulk system is also given. (auth)

18225 NONZERO MAGNETIC FIELD LEVEL-CROSSING OF 4p $^3\Pi_u$ HYDROGEN MOLECULAR LEVEL EXCITED BY ELECTRON IMPACT. Baltayan, P. (Univ. of Science and Medicine, Grenoble, France). Phys. Lett.; 42A: No. 6, 435-436(15 Jan 1973).

The fine structure of the 1s 4p $^3\Pi_u$, $\nu = 0$, $N = 1$ level of parahydrogen was measured by nonzero magnetic field level crossing: $|E_{J=1} - E_{J=2}| = 126$ MHz. (auth)

18226 ENERGY LEVELS OF NEUTRAL PRASEODYMIUM (Pr I). Zalubas, Romuald; Borchardt, B. R. (National Bureau of Standards, Washington, DC). J. Opt. Soc. Amer.; 63: No. 1, 102-103(Jan 1973).

Pr I and Pr II were observed in emission for the range 3500 to 12,000 A and in absorption for the range 2000 to 8700 A; emission exposures were taken on a 3.4-m Czerny–Turner plane-grating spectrograph in the fifth to seventeenth orders. Computer searches produced three levels of the $4f^36s^2$ 41° ground term, which are tabulated. These three levels combine with the high even levels given in another table to account for 150 lines. These upper levels have not yet been identified. The levels show good agreement with calculated level structure. (2 tables) (RWR)

18227 CONTRIBUTIONS TO THE STUDY OF SOME NUCLEAR EFFECTS BY METHODS OF OPTICAL SPECTROSCOPY. Tatu, V. S. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 8, 951-990(1972). (In Rumanian).

After a brief introduction, nuclear isotope effects in atomic spectra are considered; these include the normal and specific mass effects, the volume effect, and isotopic effects for isobaric pairs. Isotopic effects in the spectrum of Sn are then discussed. After a definition of the problem, a number of experimental aspects are treated, including the light source, the Fabry–Perot interferometer, modulation of the light signal, photomultipliers, and recording of the interference pattern. The experimental results are then presented and interpreted. The determination of radionuclide half-lives by optical methods is then taken up. The experimental method, results, and their interpretation are discussed. The conclusions reached in the work are summarized. (11 figures, 5 tables, 102 references) (RWR)

18228 AUGER ELECTRON SPECTRA OF SOME RARE EARTH METALS. Tsveiman, E. V.; Korsunskii, M. I.; Zashkvara, V. V.; Red'kin, V. S. (Inst. of Nuclear Physics, Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 204: No. 4, 828-30(1 Jun 1972). (In Russian).

Auger electron spectra were obtained for Pr, Nd, Gd, Dy, Yb, La and Hf in the energy region up to 520 eV. The measured peak energies were compared with those calculated for the seven rare earth elements. (KSW)

18229 CRITICAL CHARGE IN THE TWO-CENTER PROBLEM. Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 16: No. 6, 251-4(20 Sep 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 6, 355-8(20 Sep 1972).

The region of critical charge can be reached by using the collision of two heavy nuclei. It is necessary to find the "critical" distance in the relativistic two-center problem, i.e., that distance between charges for which the ground-state level of the quasimolecule drops to the limit -1. The results of such calculations confined to the case of equal-Z nuclei are presented. The nuclei may be reasonably regarded as pointlike. The main results are derived for spinless particles, and the results for spin-$\frac{1}{2}$ particles are stated. The formulas for the critical radius were compared with problems whose exact solutions are known, and satisfactory agreement was obtained. (RWR)

18230 OTOZHDESTVLENIE SPEKTROV ELEMENTOV. (Identification of Atomic Spectra). Kalinin, S. K.; Marzuvanov, V. L.; Zamyatina, G. M. Alma-Ata, USSR; Izdatel'stvo Nauka Kazakhskoi SSR (1972). 59p.

The book contains basic data necessary for identification of emission atomic spectra; the atlas and tables of the most sensitive lines in the ranges from 2260 Å to 6760 Å. The atlas has been arranged to fit a quartz spectrograph of average dispersion. It accurately reproduces the dimensions and type of the spectrum obtained by these instruments at a magnification of 20 times. The tables show wavelengths of spectrum lines, their appurtenance to the spectrum of neutral and ionized atoms, intensity at representative ten-point scale, level energies. Intensity of lines has been determined by their appearance in the spectrum depending on concentration of an element. Moreover, a number of additional tables are given to aid in analytical work. The book is intended for spe-

cialists engaged in the analysis of ores, minerals, rocks, metals, alloys, etc. It may be very useful for experimental work in the field of spectroscopy and its application in various branches of physics, chemistry and engineering. (15 references) (auth)

18231 UV-PHOTOEMISSION MEASUREMENTS ON ERBIUM AND SAMARIUM. Broden, G. (Chalmers Univ. of Tech., Goteborg). Phys. Kondens. Mater.; 15: No. 3, 171-190(1972).

Photoemission measurements were made on samarium and erbium in the photon energy range 4 to 21 eV. The photoelectron energy distributions are dominated by electron emission from valence band states whereas emission from 4f states is unimportant. The width and energy of the occupied and unoccupied 5d bands were determined as well as the energy relative to the Fermi level of the bottom of the valence band. A model for the unscattered yield is presented, allowing a determination of the hot-electron scattering length for some rare earths using available optical and photoemission data. (auth)

18232 COMPARISON OF THE HYPERFINE STRUCTURE OF THE $4f^96s^2$ AND $4f^85d6s^2$ CONFIGURATIONS OF THE ARC SPECTRUM OF TERBIUM. Bauche-Arnoult, C. (CNRS, Orsay, France). Compt. Rend., Ser. B; 275: No. 16, 585-588 (16 Oct 1972). (In French).

Very accurate measurements of the Childs hyperfine structure of the $4f^96s^2$ and $4f^85d6s^2$ configurations of terbium enabled a very special property of the second order perturbations to be verified. It is shown that in order to verify this property, intermediate coupling effects in the $4f^8$ core must be considered. (France)

18233 FINE-STRUCTURE MEASUREMENTS OF ^{4}He BY ZERO-FIELD QUANTUM BEATS. Wittmann, W.; Tillmann, K.; Andrae, H. J.; Dobberstein, P. (Freie Univ., Berlin). Z. Phys.; 257: No. 4, 279-287(1972).

The complete fine-structure beat frequency patterns of n ^{3}P states of ^{4}HeI (n = 3 to 7) were measured by observation of zero-field quantum beats using the beam–foil technique. The results provide a new experimental value for the $7^3P_2 - 7^3P_0$ separation, confirm the beat amplitude ratios to be in accord with theory, and allow comparison with the results of other techniques. (3 figures, 1 table) (auth)

18234 ISOTOPIC SHIFT IN ARC AND SPARK SPECTRA OF CERIUM. I. RELATIVE ISOTOPIC SHIFT OF ^{136}Ce, ^{138}Ce, ^{140}Ce, AND ^{142}Ce. Champeau, R. J. (Paris Univ., Orsay, France). Physica; 62: No. 2, 209-224(15 Nov 1972). (In French).

Optical isotope shifts between the four stable isotopes of cerium have been measured in order to compare the specific-mass shifts and the field shifts of three transitions corresponding respectively to the orbital jumps: 6p → 6s, 5d → 6s and 4f → 6s. Assuming that the specific shift of the transition $4f^26p \rightarrow 4f^26s$ of Ce II is negligible, those of the transitions $4f5d^26s \rightarrow 4f5d6s^2$ and $4f^25d6s \rightarrow 4f5d6s^2$ of Ce I for the pair ^{140}Ce, ^{142}Ce are found to be +5 mK and +23 mK, respectively, and the isotope-shift constants can be evaluated using the Fermi–Goudsmit–Segré formula; one thus finds $\beta C_{exp}(^{136}Ce,^{140}Ce) = 13 \pm 10$ mK, $\beta C_{exp}(^{138}Ce,^{140}Ce) = 17 \pm 10$ mK, and $\beta C_{exp}(^{140}Ce,^{142}Ce) = 154 \pm 15$ mK. The Hartree–Fock method gives a satisfactory explanation of the signs and of the orders of magnitude of the observed mass and field shifts. (auth)

18235 ISOTOPIC SHIFT IN ARC AND SPARK SPECTRA OF CERIUM. II. ^{140}Ce–^{142}Ce ISOTOPIC-SHIFT STUDY OF ELECTRON FACTORS. Champeau, R. J. (Paris Univ., Orsay, France). Physica; 62: No. 2, 225-238(15 Nov 1972). (In French).

The isotope shifts ^{140}Ce–^{142}Ce of many levels of the arc and spark spectra of cerium have been determined by analyzing visible and infrared lines with high resolution instruments. The influence of the mixing of the configurations $4f5d6s^2$ and $4f5d^26s$ in Ce I and $4f5d6s$ and $4f5d^2$ in Ce II is satisfactorily accounted for by the sharing rule. The field shifts of four configurations of Ce I and five configurations of Ce II have been derived; to interpret their values, the probability densities at the nucleus of the s electrons have been computed using Hartree–Fock wave functions: the theoretical results are in fairly good agreement with experiment and give an alternative way for evaluating the isotope-shift constant; one thus finds: $C_{exp}(^{140}Ce-^{142}Ce) = 137$ mK in the case of Ce I and $C_{exp}(^{140}Ce-^{142}Ce) = 143$ mK in the case of Ce II. (auth)

18236 STUDY OF RELATIVISTIC EFFECTS ON THE HYPERFINE STRUCTURE OF ^{129}Xe AND ^{131}Xe. Luc-Koenig, E. (Centre National de la Recherche Scientifique, Orsay, France). J. Phys. (Paris); 33: No. 10, 847-852(Oct 1972). (In French).

The following relativistic wave functions of Xe I are determined to zero order in the central potential approximation: 5p, 6p, 7p, 6s and 5d. In this way, the hyperfine structure of the lowest levels of ^{129}Xe and ^{131}Xe can be studied. Comparisons between these results and those obtained from empirical considerations enable relativistic effects to be distinguished from effects due to remote configuration interactions. (France)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 18439 and 18843.

18237 (LA–5110) EXOTIC: A COMPUTER CODE FOR ENERGY LEVELS OF EXOTIC ATOMS. Koch, J. H.; Sternheim, M. M. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 6p. Dep. NTIS.

EXOTIC is a FORTRAN code which finds the eigenfunctions and complex eigenvalues of the Klein–Gordon equation for K-mesic atoms. Provisions are made to allow for various models of the nuclear interaction. With some modifications this program can also be used for other exotic atoms. (auth)

18238 MAGNETIC QUENCHING OF ORTHOPOSITRONIUM IN ICE. Falciglia, F.; Iaci, G.; Lo Savio, M.; Turrisi, E. (Univ., Catania, Italy). Lett. Nuovo Cim.; 5: No. 3, 302-4 (16 Sep 1972).

The ratio R(H) between the detected annihilations of orthopositronium with and without the magnetic field was performed at a temperature of −5°C. The value of this ratio was found to be 0.86 ± 0.02. This result shows a normal behavior of positronium in ice. (JFP)

18239 NUCLEAR POLARIZED CORRECTIONS FOR THE ENERGY LEVELS OF A MESIC ATOM. Batkin, I. S. (Voronezh State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 3, 674-9(Mar 1972). (In Russian).

Nuclear polarization corrections for the energies of the 1S-state of a mesic atom were calculated, allowing for monopole, dipole, and quadrupole excitations of the nucleus. Corrections were thus obtained for the energies of the 1S-state of ^{72}Ge, ^{82}Se, ^{100}Mo, ^{106}Pd, ^{110}Pd, ^{124}Te, ^{146}Nd, and ^{150}Sm. The results obtained were somewhat too low. (KSW)

18240 INFLUENCE OF THE EFFECTIVE CHARGES OF MOLECULAR GROUPS ON π-MESON ABSORPTION BY HYDROGEN. Bersuker, I. B.; Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 203: No. 6, 1332-5(1972). (In Russian).

Certain general theoretical relations were developed between the probability of meson absorption by hydrogen and the chemical bond parameters, particularly by compounds of the type MX_q with q-equivalent hydrogen-containing absorbing groups X. The effective charges in a number of ionic and covalent compounds (metal hydroxides, ammonium halides, ammonium dichromate, and ammonium hexafluorotitanate) and their meson absorption values showed that the charge on M within the limits of one period varied only slightly. (KSW)

18241 MESONIC ATOMS. Burhop, E. H. S. (University Coll., London). pp 109-281 of High Energy Physics, Vol. III. Burhop, E. H. S. (ed.). New York; Academic Press, Inc. (1969).

The lecture on mesonic atoms includes the following topics: capture of negative mesons by atoms; x-ray spectra of mesonic atoms-experimental arrangements; x-ray spectra of muonic atoms; pionic atoms; K-mesonic atoms; hyperonic and antiprotonic atoms; muons as catalyzers of nuclear reactions; and attachment of electrons to positively charged unstable particles. (LBS)

Collision Phenomena

Refer also to abstract 18199.

18242 (COO-3427-3) NUCLEAR CHEMISTRY RESEARCH. Annual Progress Report, 1 January 1972–31 December 1972. Wolke, R. L. (Pittsburgh Univ., Pa. Wherrett Lab. of Nuclear Chemistry). 1972. Contract AT(11-1)-3427. 36p. Dep. NTIS.

Work was done in the following areas: analysis of gamma–gamma angular correlation data on levels in ^{109}Cd; collection of pre-equilibrium charge-state distribution (CSD) data for the recoils from the ^{11}B(d,d) reaction; investigation of equilibrium CSD's in targets of different chemical structures to search for the existence of a medium effect; determination of the equilibrium CSD of Be recoils using recoils from the ^{11}B(d,α) reaction; determination of the pre-equilibrium CSD of a nuclear reaction recoil at significantly higher velocity than those observed in the past, on

the $^{11}B(d,\alpha)$ reaction; use of position-sensitive detectors in the CSD experiments; calculation based upon a model for recoil CSD's; testing of a novel method of tritium enrichment in water by electrolysis; and development of computer programs pertinent to the research program. (4 figures, 7 tables) (RWR)

18243 (N-72-27756) IMPULSIVE MODEL FOR REACTIVE COLLISIONS. Marron, M. T.; Bernstein, R. B. (Wisconsin Univ., Milwaukee. Theoretical Chemistry Inst.). 25 Feb 1972. 71p. (NASA-CR-127260; WIS-TCI-470). NTIS.

A simple classical mechanical model of the reactive scattering of a structureless atom A and a quasi-diatomic BC is developed that takes full advantage of energy and linear and angular momentum conservation relations, but introduces a minimum of further assumptions. These are as follows: (1) the vibrational degree of freedom of the reactant (BC) and product (AB) molecules is suppressed, so the change in vibrational energy is simply a parameter; (2) straight-line trajectories are assumed outside of a reaction shell; (3) within this zone, momentum transfer occurs impulsively (essentially instantaneously) following mass transfer; (4) the impulse, which may be either positive or negative, is directed along the BC axis, which may, however, assume all orientations with respect to the incident relative velocity. The model yields differential and total cross sections and product rotational energy distributions for a given collision exoergicity Q, or for any known distribution over Q. Numerical results are presented for several prototype reactions whose dynamics have been well studied. (auth)

18244 (SC-RR-720874) INTERACTION OF RELATIVISTIC ELECTRON BEAM WITH NEUTRAL GAS. McArthur, D. A.; Poukey, J. W. (Sandia Labs., Albuquerque, N. Mex.). Jan 1973. 63p. Dep. NTIS.

Theoretical and experimental studies have been made of the interaction between an electron beam and neutral nitrogen gas. Beams of several currents and energies were investigated, and satisfactory agreement between theory and experiment was found. The model used includes primary and secondary ionization processes, electron-neutral and electron-ion collisions, recombination and depletion of N_2 molecules. Detailed results for the return current in the beam-produced plasma are presented. An application of the model to a problem of interest in beam-combining experiments is given. (auth)

18245 (UCRL-51268) K-SHELL COMPTON SCATTERING ON TIN AND GOLD AT 145 keV AND GOLD AT 320 keV. Wittwer, L. A. (California Univ., Livermore. Lawrence Livermore Lab.). 11 Aug 1972. Contract W-7405-Eng-48. 36p. Dep. NTIS.

A numerical calculation is given for the inelastic K-shell cross sections of tin with an incident energy of 145 keV and of gold at 145 and 320 keV. The calculation is based on second-order perturbation theory. The bound initial state is the relativistic Hartree–Fock–Slater single-particle $1s_{\frac{1}{2}}$ eigenfunction for the particular element concerned. The relativistic scattering solutions are constructed from continuum total spin eigenfunctions of the self-consistent potential field of the parent configuration. The necessity of using both negative and positive energy eigenfunctions is demonstrated when the Dirac relativistic formalism is used. The calculated spectra are the sum of the Compton line and the infrared divergence, with the Compton line being dominant. The Compton line displays the Compton defect and line broadening found at higher incident energies. The Compton line is also almost entirely due to negative-energy, intermediate-state transitions. The infrared divergence, on the other hand, is due entirely to positive-energy, intermediate-state transitions. (auth)

18246 MECHANISM OF INELASTIC TRANSITION IN Li^+–He COLLISIONS. Afrosimov, V. V.; Gordeev, Yu. S.; Lavrov, V. M. (Ioffe Physical-Technical Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 341-344(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 480-484(20 Oct 1972).

The inelastic transitions occurring in collisions between light particles when the very close approach of the nuclei can be easily attained are investigated. A Li^+ was passed through a helium-filled collision chamber at 0.6 to 4.0 keV at 1 to 10°. The differential cross sections were obtained as functions of the inelastic energy loss. It was established that the studied collisions excite with maximum probability the He levels $1s2p\,^1P$, $2s^2\,^1S$, $2p^2\,^1D$, and $2S2p\,^1P$ for which the excitation differential cross sections and the elastic scattering cross sections are shown. Various properties of the excitation mechanism of inelastic transitions in the studied collisions are discussed. (JFP)

18247 EXCITATION OF AN ATOM BY A SIMULTANEOUS ENCOUNTER WITH ANOTHER ATOM AND A PHOTON. Buimistrov, V. M.; Trakhtenberg, L. I. (Moscow Physical-Technical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 66-71(1972). (In Russian).

A novel mechanism for the excitation of an atom caused by the simultaneous collision of that atom with another atom and a photon was examined. The cross section of the excitation of the atom was calculated. For experimentally achieved intensities of the electromagnetic field and other real parameters, this cross section was comparable with the cross section of an atomic excitation by impact with an electron. (tr-auth)

18248 ELECTRON IMPACT DOUBLE IONIZATION OF NOBLE GAS ATOMS. Roy, B. N.; Tripathi, D. N.; Rai, D. K. (Banaras Hindu Univ., India). Can. J. Phys.; 50: No. 23, 2961-2966(1 Dec 1972).

Cross sections for double ionization by electron impact for noble gas atoms were calculated using Gryzinski's classical expression. The effect of including ionization from the inner shell was discussed in connection with possible Auger emission. Calculated cross sections were compared with the available experimental results and also with calculated values of proton impact double ionization cross sections. (auth)

18249 UNIFIED FORMULA FOR THE INELASTIC DIFFERENTIAL CROSS SECTION FOR SCATTERING OF ATOMS AND THE PROBLEM OF DETERMINING THE EXCITED TERM PARAMETERS. Elisenkov, F. A.; Nikulin, V. K. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 64: No. 1, 122-128(Jan 1973). (In Russian).

A single formula valid for all scattering angles is derived for the inelastic differential cross section within the framework of the model two intersecting terms. It is shown that the expression obtained correctly matches previously obtained formulas for threshold rainbow behavior of the cross section and quasiclassical interference for scattering angles far from the threshold which is due to the presence of two trajectories. A procedure for determining the excited term parameters by employing experimental data on inelastic scattering and the unified formula is considered. The advantages and refinements which the procedure yields compared to the approaches employed in previous work are discussed. Concrete calculations are carried out for the He^+–Ne pair for a collision energy of 71 eV. (auth)

18250 SODIUM SATELLITE STRUCTURE. Moore, C. F.; Olsen, D. K.; Hodge, B.; Richard, P. (Univ. of Texas, Austin). Z. Phys.; 257: No. 4, 288-291(1972).

A sample of sodium was bombarded by proton, helium, and oxygen beams, and the subsequent K x-ray spectra were measured. The spectra exhibit a preponderance of structure, which is speculated upon in light of HFS calculations. The strongest lines were ascertained to be the normal $K\alpha$ satellite spectra produced by multiple electron vacancies in single ion–atom collisions. (1 figure, 1 table) (auth)

Atomic Theory

Refer also to abstracts 18397 and 18538.

18251 STRUCTURE OF MATTER. Rutherford Centennial Symposium Held at Christchurch, New Zealand, 7–9 July 1971. Wybourne, B. G. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1972). 546p. $17.50. (CONF-710733).

Separate abstracts were prepared for twenty-six of the papers in this book. Two others, Quantum theory of atomic coherence effects and Sur origines de la mecanique ondulatoire et mes idees actuelles a ce sujet, were not found to be in the subject scope of NSA. In addition, this book contains a brief biography of Ernest Rutherford. (RWR)

For abstracts of individual papers see: 17965, 18023, 18024, 18222, 18252–18255, 18317, 18350, 18351, 18376, 18426, 18523, 18524, 18542, 18543, 18658, 18695, 18771, 18793–18797, and 19043.

18252 GROUP STRUCTURE OF THE PERIODIC SYSTEM. Barut, A. O. (Univ. of Colorado, Boulder). pp 126-36 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The global group structure of the periodic system is discussed in which the different elements in their ground states are regarded as different "states" of atomic matter. All levels of the H atom can be considered to be a single "multiplet" of the dynamical

group SO(4,1) or SO(4,2); in this way the dynamical problem is solved group-theoretically. This same idea is applied to the periodic system. If there are (global) quantum numbers that would characterize the elements as different "states" of a single system, then all elements would constitute a single "multiplet." These ideas are pursued for highly ionized and then neutral elements. The levels found separate into two groups, and the physical significance and mathematical interpretation of this result are given. The paper concludes with the rules for passage from the oscillator shell model to the hydrogenic shell model. (7 figures) (RWR)

18253 DEVELOPMENTS IN ATOMIC SHELL THEORY. Judd, B. R. (Johns Hopkins Univ., Baltimore). pp 406-26 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

Much of the recent interest in atomic shell theory has been associated with the increased use of group theory in tackling problems involving many electrons in open shells. Problems still remaining are those directly connected with the analysis of experimental data and those that arise because of peculiarities or unexpected simplifications of the mathematics. The question of the choice of effective operators that need to be included in the term analysis of a complex configuration is a very good example of the use of group theory in analyzing experimental data. An extension of present techniques to cope with effective three-electron scalar interactions for the configuration $4f^N$ is described. Discussion of the above-mentioned simplifications includes complementary groups, generators, the kaleidoscope group (or Weyl group), SU_3 for f electrons, more suggestive zeros, and multiplicity resolution with E_6. (5 tables) (RWR)

18254 FULL CORRELATION IN HARTREE-FOCK THEORY. Fimple, W. R. (Univ. of Canterbury, Christchurch, New Zealand). pp 454-80 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The Boys-Handy approach for calculating energies and wave functions for many-electron atoms with full explicit r_{ij} dependence and integrals of no more than six dimensions is developed further; and the solution of the resulting variational equations is shown to be an extension of the well-known Hartree-Fock self-consistent field iteration. One is able to see directly the corrections to the Hartree-Fock wave function and energy due to the addition of full electronic correlation. The so-called transcorrelated Hamiltonian C^{-1} HC, which is a non-Hermitian operator, is shown to be readily expressible as a sum of Hermitian and anti-Hermitian parts, the latter not contributing to the variation of Φ in the Hartree-Fock equations. The fully correlated Roothan equations are presented and discussed, and the variation of the correlation function is considered. A proposed set of atomic radial basis functions and the resulting specific forms of the two- and three-particle operators are presented. Finally, preliminary calculations are set forth for very simple correlated wave functions that satisfy the cusp conditions, and the associated energy for the ground state of the Be atom is found. (2 figures, 2 tables) (RWR)

18255 SYMMETRY METHODS FOR CORRELATION IN ATOMS. Innes, F. R. (Hanscom Field, Bedford, MA). pp 482-98 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

Correlation in atoms by insertion of higher-order wave functions, whether in a Hartree-Fock or a hydrogenic basis, accepts the use of parentage methods in a very natural way. It is shown that the correlation methods under discussion are fully symmetry adapted. After a lengthy introduction, the correlated wave function, the densital, and the correlation energy are considered. (RWR)

18256 METHOD OF EXCITED STATIONARY STATES. Matveenko, A. V.; Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.: 16: No. 3, 620-3 (Sep 1972). (In Russian).

The correct energy spectrum of an isolated atom for infinite nuclear separation nuclei was obtained for a system of three particles (electron and two nuclei). Thus the groundlessness of general objections against the method of excited stationary states connected with boundary conditions of the problem was proved. The results obtained are independent of the type of pairwise interaction between particles. (auth)

18257 UNIDIMENSIONAL MOTION IN AN ELECTRIC NON-HOMOGENEOUS FIELD WITH COULOMBIAN POTENTIAL (QUANTUM-MECHANICAL TREATMENT). Malvestuto, V. (Univ., Rome); Zirilli, F. Lett. Nuovo Cim.: 5: No. 3, 241-4 (16 Sep 1972).

Some restrictions are found on an external electric potential sufficient to assure that a discrete spectrum of bounded eigenstates exists for an electron in a one-dimensional atom. (JFP)

18258 ITERATIVE SOLUTION OF THE HARTREE-FOCK EQUATIONS WITH IMPROVED STABILITY. Fischer, C. F. (Univ. of Waterloo, Ont.). J. Comput. Phys.: 10: No. 2, 211-23 (Oct 1972).

Standard methods for solving the Hartree-Fock equations for excited states often fail to converge or oscillate about the solution. Two new methods with improved stability properties are proposed which require only one computation of the exchange function per SCF iteration. These methods have solved satisfactorily all the cases found to be unstable by Griffin, Cowan and Andrew as well as other test cases. (auth)

18259 TOPICS IN ATOMIC AND NUCLEAR THEORY. Judd, B. R.; Elliott, J. P. University of Canterbury Publication No. 12. Christchurch, N. Z.; University of Canterbury (1972). 122p.

There were two lectures included. Separate abstracts were prepared for both lectures. (JFP)

For abstracts of individual lectures see: 18260 and 18836.

18260 TOPICS IN ATOMIC THEORY. Judd, B. R. (Johns Hopkins Univ., Baltimore). pp ix-xii; 1-60 of Topics in Atomic and Nuclear Theory. /Judd, B. R. Christchurch, N. Z.; Univ. of Canterbury (1972).

The lectures cover couplings, godparents, quasi-spin, groups, defining states, and quasi-particles. (JFP)

18261 LEVEL CROSSING EFFECT WITHIN A MAGNETIC FIELD MODULATED WITH A RADIO FREQUENCY (rf) FIELD. Apparatus Design and Construction. Application of Level Crossing Effect for $^{32}P_{\frac{1}{2}}$ Na Level Life-Time Measurements. Dohnalik, Tomasz. Zesz. Nauk. Univ. Jagiellon., No. 263, Pr. Fiz.; No. 9, 73-108(1971). (In Polish).

A technique for measuring the lifetime of excited atomic levels by means of level crossing effect analysis in constant and modulated magnetic fields is presented. The apparatus constructed for this purpose is also described. The measurement concerned the lifetime of the ^{23}Na excited $3^2P_{\frac{1}{2}}$ level. The theory of the Zeeman level crossing effect, employing the density matrix formalism, is outlined. The starting point of calculations is the equation describing optical pumping processes within an excited level. Zero-field level crossing (Hanle effect) and hyperfine structure excited level crossing (at higher magnetic fields) are described. Through the use of the same density matrix method, changes of excited level crossing are discussed for the case when the magnetic field is modulated with an rf field. The nature of the above changes lies in the appearance of additional resonance signals, constant and modulated, marked in this work as rf resonance. The general case of hyperfine structure level crossing is analyzed. It is shown on the basis of results obtained that, by applying an rf magnetic field, the lifetimes of levels can be calculated independently of the Landé factor and without any knowledge of the constant magnetic field intensity value. The description is given of the Cohen-Tannoudji model of atomic interactions with an rf field by applying the model of a "dressed atom" with rf photons. Rf resonance positions are calculated by using the "dressed atom" model. The apparatus for observing the above effects (for ^{23}Na atom $3^2P_{\frac{1}{2}}$ level) is described. The calculated lifetime of this level — $(1.59 \pm 0.06) \cdot 10^{-8}$ s — agrees well with the measurements published by other authors. There is also observed a change in the level crossing effect after application of the rf magnetic field, which modulates the constant magnetic field, with particular emphasis put on the rf resonance from different hyperfine structure level crossing. (18 figures, 2 tables) (auth)

18262 SCREENING OF NUCLEAR CHARGE IN THE ELECTRON SHELLS OF ATOMS ACCORDING TO THE RUTHERFORD-BOHR ATOM MODEL. II. SHADING CONCERNING THE ELECTRON GROUPING OF THE ATOM. Kilpi, S. (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A II; No. 164, 1-16(1972). (In German).

The factor n/ν is determined by the x-ray spectra of the elements through states. It presents the bond activity of the unscreened part of nuclear charge in regard to the electron of the electron shell of the atom. The counted energy values according to the n/ν-values received follow the electron grouping of the base states of the atom. (tr-auth)

18263 RELATIVISTIC CORRECTIONS TO THE UNIVERSAL POTENTIAL. Gaspar, R.; Erdoes-Gyarmati, G. (Kossuth Lajos

Univ., Debrecen, Hungary). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 17-41(1972).

Atomic one-electron energies were calculated with the aid of a universal potential. For solution of the radial Schroedinger equation Noumerov's method was applied, while relativistic and spin–orbit coupling corrections were taken into account. The results are compared with experimental energy levels as well as with the results of other nonrelativistic and relativistic calculations. (auth)

18264 SHAPE OF THE TOTAL INELASTIC CROSS SECTION CURVES IN ATOMIC COLLISIONS. Ovchinnikova, M. Ya. (Inst. of Chemical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 1, 129-138(Jan 1973). (In Russian).

The possibilities of obtaining additional information on the terms of a diatomic system by analyzing the curves of the total inelastic cross section due to quasi-intersection of terms are studied. An investigation involving a more accurate calculation of the transition probability than that employed in the Landau–Zener model is carried out on the influence of the characteristic parameters on the shape of the total inelastic cross section as a function of energy. It is shown that the maximum value of the cross section may exceed that which the Landau–Zener theory yields by 1.5 to 2 times depending on the magnitude of the interaction (parameter A). The position of the maximum with respect to energy appreciably varies depending on the rate of variation of the interaction (parameter v). (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 17837.

18265 (FRNC-R-15) STUDY OF MAGNETOAERODYNAMIC PHENOMENA. Dubois, P.; de Simone, J. C. (Compagnie Generale d'Electricite, Marcoussis (France)). 20 Apr 1971. 17p. (In French). Dep. NTIS (U. S. Sales Only).

Magnetoaerodynamic phenomena in nozzles having cross sections of several dozen square centimeters were investigated in view of applications to the direct conversion of thermal energy into electrical energy. Loss mechanisms due to the boundary layer in linear Hall effect nozzles with circular cross sections (short circuiting between the electrodes, apparent reduction in the useful volume of the nozzles) were investigated. Temperature and velocity profiles were used to study the breaking away of the boundary layers in the supersonic region. Methods of increasing the conductivity of the boundary layer facing the electrodes are presented, the use of high temperature ceramics (zirconia) being avoided. These methods involve insulating the electrodes from one another and maintaining low wall temperatures. Liquid metal electrodes were developed (potassium) and an insulation effected by blowing air was studied in view of applications to Hall effect type nozzles. (auth)

18266 INFLUENCE OF THE HALL EFFECT ON FLOW STRUCTURE DURING THE FLOW OF PLASMA IN A SPACE-PERIODIC MAGNETIC FIELD. Cherkasova, K.P. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 11-16(1972). (In Russian).

The structure of electric fields and fluxes was studied during steady-state plasma flow in an axially-symmetric space-periodic magnetic field. The problem was solved in a MHD approximation allowing for the Hall term in a generalized Ohm's law. It was assumed that the magnetic Reynold's number and the parameters of interaction were small. (tr-auth)

18267 HYDROMAGNETIC OSCILLATORY FLOW ALONG AN INFINITE FLAT PLATE WITH VARIABLE SUCTION. Rao, V. V. R.; Sithapathi, A. (Andhra Univ., Waltair, India). Proc. Indian Acad. Sci., Sect. A; 76: No. 4, 157-161(Oct 1972).

The two-dimensional, incompressible flow past an infinite plate of a weakly conducting fluid in the presence of a transverse magnetic field is discussed when the suction velocity normal to the plate as well as the external flow velocity vary periodically with time. Expressions for the velocity and the skin-friction in the boundary layer were obtained in a nondimensional form. (auth)

18268 THREE-DIMENSIONAL MHD DUCT FLOWS WITH STRONG TRANSVERSE MAGNETIC FIELDS. PT. 4. FULLY INSULATED, VARIABLE-AREA RECTANGULAR DUCTS WITH SMALL DIVERGENCES. Walker, J. S.; Ludford, G. S. S. (Univ. of Illinois, Urbana). J. Fluid Mech.; 56: No. 3, 481-496(12 Dec 1972).

In a previous paper (Walker, Ludford, and Hung, J. Fluid Mech.; 56: 121-41(1972)) a prototype was considered with insulating side walls at $z = \pm 1$ for all x and insulating top and bottom walls at $y = \pm a$ for $x < 0$ and at $y = \pm (a + bx)$ for $x > 0$, where the applied magnetic field is in the y direction and the flow is in the x direction. In the diverging portion ($x > 0$) of this duct, the entire mass flux is carried by high-velocity jets adjacent to the side walls, while the fluid elsewhere is stagnant. In the constant-area portion ($x < 0$), the fully developed flow is severely disturbed as it approaches the join at $x = 0$, and high-velocity jets occur even before the top and bottom walls begin to diverge. The analysis presented there is not valid in the limit $b \to 0$, and the object of this paper is to reconcile the stagnant core flow for $b = 0$ with the fully developed flow for $b \neq 0$. Conditions are such that inertia forces are negligible. The first transitional stage occurs when $1 \gg b \gg M^{-\frac{1}{2}}$, where M is the (large) Hartmann number. The upstream disturbance disappears, and downstream each of the $O(M^{-\frac{1}{2}})$ side-wall boundary layers splits into an $O(b^{-1}M^{-\frac{1}{2}})$ outer layer and an $O(M^{-\frac{1}{2}})$ inner layer. The fluid outside these layers is still stagnant and an $O(bM^{\frac{1}{2}})$ velocity in the outer sublayers accounts for the mass flux. The viscous inner sublayers reduce the velocity in the outer sublayers to zero at the side walls. The second transitional stage occurs when $b = O(M^{-\frac{1}{2}})$. The outer sublayers spread across the entire duct so that none of the fluid is stagnant, and an O(1) core velocity accounts for the mass flux. This analysis is valid no matter how small b becomes, and as $b \to 0$ the fully developed solution is recovered everywhere. (auth)

18269 ELECTROMAGNETIC CHARACTERISTICS OF MHD CHANNELS WITH NONCONDUCTING WALLS AT FINITE MAGNETIC REYNOLDS NUMBERS. Batazhin, A. B.; Zvenigorodskii, E. G.; Kashkin, Yu. F.; Regirer, S. A.; Kholshchevnikova, E. K. Magn. Gidrodin.; No. 1, 19-30(1972). (In Russian).

The magnetic fields induced at a constant flow rate in MHD channels with nonconducting walls were studied theoretically. The initial approximation equations were based on the evaluation of transition to the two-dimensional problem. The theoretical results were compared with experimental data obtained with the ionized gas flowing through a rectangular cross-section channel and liquid metal flowing through a round pipe at magnetic Reynolds numbers up to 20. Study of the dependence of the sensitivity of the flow meter at the center of the homogeneous field on the magnetic field and the Reynolds number revealed that the sensitivity decreases substantially as the magnetic Reynolds number increases. A family of curves was derived, allowing to determine the external field configuration—or more exactly—the ratio between the length of the homogeneous field and the zone of scattering which indicates the required level of sensitivity. (TTT)

18270 FLOW OF REAL GAS IN ANNULAR CHANNELS WITH CURVILINEAR WALLS AT HIGH MHD INTERACTION PARAMETERS. Bertinov, A. I.; Kovalev, L. K.; Koneev, S. M.; Nikitin, Yu. M. Magn. Gidrodin.; No. 1, 31-38(1972). (In Russian).

Several two-dimensional problems involving the subsonic flow of nonviscous and nonheat-conducting gases in annular MHD channels were examined under conditions of MHD parameters and Euler's numbers much larger than unity, while the magnetic Reynolds number and the Hall parameters were small. It was assumed that the conductivity and the density are functions of the enthalpy and pressure. It was shown that in the absence of an electric field in the channel the problem is that of the flow of a noncompressible fluid. An approximate solution was obtained for a gas flowing in an annular channel with curvilinear walls, whereby it was assumed that there are no nonconducting meridianal partitions in the channel. The conditions resulting in the establishment of a stagnant zone in such a channel were determined. If the terminal effects are suppressed and the gas has a constant enthalpy along the cross section the usual differential equation system is obtained. The results are illustrated in an annular channel without nonconducting meridianal partitions. They indicate that in case of high MHD parameters the compressibility of the gas considerably affects the flow rate in the channel. (TTT)

18271 TRANSVERSE EDGE EFFECT IN A RECTANGULAR MHD CHANNEL WITH A SEGMENTED SIDE WALL. Bertinov, A. I.; Kovalev, L. K.; Tyutin, V. K. Magn. Gidrodin.; No. 1, 39-46(1972). (In Russian).

A rectangular MHD channel was studied. It was provided with solid 2 L-wide electrodes and the ratio of the sides was $\lambda = L/H$; its sidewall consisted of n identical conducting layers (modules), separated from each other by 2Δ-high insulating inserts. The external magnetic field was B; the conductivity along the cross-section was kept constant. The axial velocity v of the gas was calculated as an even function of the x coordinates, corresponding approximately to a gas flow through the channel at low MHD parameters, on the assumption of a thin boundary layer at the electrodes. The current density distribution in the channel was found to be periodic, with a period of $2H/m$; the current and the potential could be determined on the basis of the channel segment containing one module. The solution was based on a conformal projection of the channel segment on a rectangle with insulated sidewalls. The potential and current distribution along the cross-section of the channel was also determined. The zone of nonuniform current distribution in the channel is determined by the size of the eddy current in the conducting module ($\sim H/m$). The potential distribution along the insulating insert near the edge of the module was found to be nonlinear. The Joule losses, leakage currents, voltage drop coefficients, were determined as a function of the relative width of the channel λ, the number of modules, and the number of insulating inserts $\Delta n/H$. (TTT)

18272 FLOW WAVE REGIME OF A THIN FILM OF A CONDUCTING FLUID IN A TRANSVERSE MAGNETIC FIELD. Vishnyakov, V. I.; Pavlov, K. B. Magn. Gidrodin.; No. 1, 47-52(1972). (In Russian).

In order to understand the processes taking place in some MHD devices, the motion of thin layers of conducting, viscous fluid, discharged through an inclined nonconducting wall, in a transverse magnetic field at a constant tangential voltage applied at the free surface, was investigated. The asymptotic "narrow band" method was used to solve the problem; this method used profiles of the waves generated at the free surface of the layers as a func-

tion of the determining parameters. Results of calculations based on the obtained relationships revealed that an increase of the external magnetic field results in an increase of the amplitude and the wave length; the tangential voltage has a similar effect on the amplitude, in agreement with the results obtained by L. V. Pashinin. (TTT)

18273 STABILIZATION OF MAGNETOHYDRODYNAMIC FLOW BY MEANS OF A DISTRIBUTED FEEDBACK SYSTEM. Arsenin, V. V.; Sergievskii, E. D. Magn. Gidrodin.; No. 1, 53-57(1972). (In Russian).

The tangential discontinuity between moving, ideally conducting and stationary nonconducting ideally incompressible fluids was investigated, considering the stabilization of a plane-parallel flow with velocity shift of an electrically conducting fluid by the application of an external magnetic field. It was shown that the flow, which is unstable with respect to small initial perturbations in a channel with metallic walls, can be stabilized by exciting currents at the boundary of the fluid. These currents are proportional to the perturbation of the magnetic field at the interface. The tangential break in the conducting fluid may be stabilized by the application of a strong, constant magnetic field. The results also indicated that in case of long-wave oscillations a feedback system may help to avoid the spatial amplification of perturbations with a given frequency spectrum introduced into the current. (TTT)

18274 STABILITY OF THE HARTMANN LAW WITH RESPECT TO TWO-DIMENSIONAL, FINITE-AMPLITUDE PERTURBATIONS. Pavlov, K. B.; Simkhovich, S. L. Magn. Gidrodin.; No. 1, 58-64(1972). (In Russian).

The results of the theory of the hydrodynamic stability of laminar flow toward infinitely small perturbations do not agree well with experimental data. This divergence is especially noticeable in the case of the stability of a plane-parallel gradient flow of a conducting Newtonian liquid in a transverse magnetic field (Hartmann flow). This problem was examined by studying the hydrodynamic stability of the Hartmann flow to a plane, two-dimensional finite-amplitude perturbation. Results of calculations for Hartmann numbers of 0, 1, and 2 allowed to derive the dependence of critical Reynolds numbers on the amplitude of the perturbation, at which the stability of laminar flow starts to be effective. The problem has been studied by another author who used the energy method; however, that method yielded too low values for the critical Reynolds number. (TTT)

18275 TWO-DIMENSIONAL, NONSTATIONARY FLOW OF A WEAKLY CONDUCTING FLUID NEAR THE CRITICAL POINT IN THE PRESENCE OF A MAGNETIC FIELD. Sharikadze, D. V. Magn. Gidrodin.; No. 1, 65-69(1972). (In Russian).

The problem of a two-dimensional, unsteady flow of a weakly-conducting viscous, incompressible fluid on an infinite plane was investigated while an external uniform magnetic field was acting in a direction perpendicular to the flow. Flow conditions near the critical point were determined without taking the induced magnetic field into account. The similar previous study of J. L. Neuringer and W. McIlroy was generalized, using integral equations, deriving an explicit Green function and solving second-order Volterra equations by means of successive approximations. This helped to determine the conditions of convergence of these functional series. It was shown that if a magnetic field is applied at the two-dimensional flow, the movement of the fluid across the lines of force is impeded. The actual value of this impediment was also determined. (TTT)

18276 MAGNETOHYDRODYNAMIC FLOW IN THE REGION OF THE CONDUCTIVITY JUMP AT THE WALL. Kolesnikov, Yu. B.; Tsinober, A. B. Magn. Gidrodin.; No. 1, 70-74(1972). (In Russian).

Following up previous visual experiments, which indicated that the nonuniformity of the conductivity of flow boundaries lying perpendicularly with respect to the magnetic field cause strong distortions in the flux, the flow of an electrically conducting fluid was investigated, using a channel with a sharply changing conductivity of the wall. A model was used to consider the electric current distribution for the case of the movement of the medium with a uniform velocity profile in a homogeneous magnetic field; experiments were also carried out with a mercury loop, measuring the velocity distribution with a Pitot–Prandtl tube. It was found that the nonuniform velocity profile is created in the plane lying perpendicularly with respect to the pole. This was attributed to the gradient of the electric current component along the field. Behind the copper insert, where the velocity profile undergoes inflection, a perturbation up to about 15% was observed. (TTT)

18277 SWINGING OF A CYLINDER IN THE PRESENCE OF A MAGNETIC FIELD IN A PLANE COVERED WITH A VISCOUS CONDUCTING FLUID. Shvarts, I. A. Magn. Gidrodin.; No. 1, 75-80(1972). (In Russian).

The magnetohydrodynamic problems involved in the swinging of a cylinder within a uniform magnetic field with respect to the plane covered with a thin layer of an electrically conducting viscous fluid were investigated. Both the conventional and the magnetic Reynolds numbers were low. The problem was resolved in two series of measurements whereby the boundary conditions were the same in the usual MHD approach. The results consisted of formulas which indicated the velocity distribution in the fluid layer under the cylinder and in integral expressions of the pressure in the layer at high and low Hartmann numbers. A similar approach was used to examine the cases in which the ratio of the thickness of the fluid layer to the diameter of the cylinder was low, simplifying the pressure and velocity formulas. It was shown that if the Hartmann number is increased, the boundaries of the positive pressure region in the layer are narrowed, while the maximum pressure is increased. It was also found that in a strong magnetic field the friction coefficient of the swinging is small and does not depend on the viscosity of the fluid. (TTT)

18278 APPROXIMATION CALCULATION OF ELECTRODYNAMIC FORCES ACTING ON A SPHERE IN A TRAVELING MAGNETIC FIELD. Krumin, Yu. K. Magn. Gidrodin.; No. 1, 111-114(1972). (In Russian).

Although the mathematical determination of the position of a conducting sphere within a traveling magnetic field is difficult, the calculation is greatly simplified if the skin effect is weak as in the case when the force acting on the sphere is directly proportional to the relative frequency (the magnetic Reynolds number) and the sphere is placed in a cylindric inductor. The study revealed that in case of a finite solid cylinder placed in a traveling magnetic field of a cylindrical inductor, the proportionality coefficient between the relative force and the relative frequency does not depend on the length of the cylinder. An expression was derived to give its value in case of infinite length. The theoretically derived results were experimentally confirmed, indicating that it is possible to determine the approximate force acting on the cylinder by using a formula derived for finite-length cylinders. (TTT)

18279 SUPPRESSION OF TURBULENCE BY A MAGNETIC FIELD. Tseskis, A. L. Magn. Gidrodin.; No. 1, 147-148(1972). (In Russian).

From the physical viewpoint, the suppression of turbulence by a magnetic field is quite obvious as it has been shown that the presence of the field helps to reduce the intensity of pulsations and the degrees of freedom in a turbulence spectrum. The effect was examined for the case when the Reynolds number exceeds slightly the critical value. The calculations based on the perturbation theory indicated that for low values of the $\sigma B^2/\rho$ parameter, application of the magnetic field indeed reduces the turbulence and lowers the intensity of pulsations, in agreement with the findings of G. G. Branover et al. (TTT)

18280 STUDY OF THE CONDUCTIVE ROTATION OF A CONDUCTING FLUID IN A CYLINDRICAL VESSEL. Zibol'd, A. F.; Kapusta, A. B. Magn. Gidrodin.; No. 1, 148-151(1972). (In Russian).

The distribution of the azimuthal velocity of a finite-length cylindrical vessel filled with a conducting liquid was investigated. It was found that the azimuthal flow may be excited by homogeneous magnetic and inhomogeneous electric fields. This conductive rotation technique was used to mix liquid metals in order to enhance the heat transfer. As a model for the process, the stationary, axially-symmetric, laminar azimuthal flow of viscous, incompressible liquid in a cylindrical vessel was investigated under the influence of electromagnetic forces. These forces consisted of an axial, constant magnetic field and a direct current applied by means of axially-symmetric electrodes. The calculation revealed that within a fairly broad range the average velocity is decreased when the radius of the frontal electrode is increased; in addition, the optimum dimensions of the vessel and operating conditions were also determined. (TTT)

18281 EXPERIMENTAL STUDY OF THE ELECTROMAGNETIC FORCES AND FLOW OF A LIQUID CYLINDER WITHIN A TRAVELING MAGNETIC FIELD. Kudrenko, G. V.; Sokolovskii, V. A.; Chekin, B. V.; Shelukhin, E. M. Magn. Gidrodin.; No. 1, 151-153(1972). (In Russian).

The use of rotating magnetic fields to stir melts in axially symmetrical containers is reviewed; the electromagnetic forces involved in the operation and the motion of the conducting liquid held within finite-dimension cylinders under the influence of a traveling magnetic field were investigated using cylinders made of several metals. Forces were measured by means of a spring

dynamometer. The results indicated that the electromagnetic forces acting on the cylinder are proportional to the square of the excitation current. This agrees with the findings reported by N. M. Okhremenko, indicating that the method used was reliable. It was also found that a critical Reynolds number Re_{cr} was reached when the liquid moved under the action of the traveling magnetic field; in the specific case, Re_{cr} was about 40,000. Thus, motion of the liquid $Re > Re_{cr}$ creates an instability which in turn generates meridional vortices. (TTT)

18282 INTERACTION OF FAST MAGNETOSONIC AND SHOCK WAVES. Granik, A. T. Magn. Gidrodin.; No. 2, 20-24 (1972). (In Russian).

The collision of a shock wave, propagating in an ideal electrically conducting gas within a fast magnetosonic wave, was investigated using rectangular coordinates in which the breakage surface is at rest at the X = 0 plane. The gas moves through it in the positive direction of the X axis; the incident magnetosonic wave travels in the same direction. The unperturbed magnetic field is nearly proportional with the plane of breakage. Under the influence of the incident wave, the shock wave fronts start to oscillate. Three magnetosonic and one enthalpy waves travel in the positive direction of the X axis. The equation system describing the phenomenon was solved, yielding an explicit expression of the ratio of the pressure in the incident and outgoing fast waves. This ratio was found to be lower than D. I. Brokhintsev's corresponding gasodynamic derivation. (TTT)

18283 DEFORMATION OF HYDRODYNAMIC PERTURBATIONS IN A UNIFORM MAGNETIC FIELD. Kalis, Kh. E.; Tsinober, A. B. Magn. Gidrodin.; No. 2, 25-28(1972). (In Russian).

Perturbations encountered in electrically conducting fluids flowing in a magnetic field tend to conserve only the vorticity component parallel to the magnetic field; it also deforms in such a way as to render its dimensions in the direction perpendicular to the flow much smaller than in the direction parallel to the flow. In order to clarify this problem, the plane flow conditions were numerically calculated in an annular region, the boundaries of which rotated at a constant rate. The results revealed that at first the magnetic field includes the inertial forces, then, as the magnetic field increases, the role of the inertial forces becomes weaker and Stokes-type flow is established. Cartesian coordinates were used in the calculation. At Reynolds numbers of Re = 500, unilateral differences were used to approximate the derivation. (TTT)

18284 TURBULENCE AND SOME PROBLEMS OF FLOW STABILITY IN CASE OF M-SHAPED FLOW VELOCITY PROFILES. Platnieks, I. A.; Freiberg, Ya. Zh. Magn. Gidrodin.; No. 2, 29-34(1972). (In Russian).

When the length of the MHD channels is negligible, their cross-section is variable and magnetic field gradients are large, the velocity profiles become strongly nonuniform; therefore, study of large flow gradients induced by the magnetic field present considerable interest. This problem of turbulence characteristics of flows with large velocity gradients was experimentally investigated in the direction perpendicular to the magnetic field using a rectangular channel with conducting (copper) walls. It was shown that under such flow conditions in spite of the inhibiting effect of the field, the level of turbulence is sharply increased in the high-gradient zone. In the transverse field, the conducting surface in contact with the liquid reduces the turbulence level, stopping its generation under certain conditions. By taking advantage of such an interaction, a pulsation-free, laminar MHD flow was obtained in short channels. (TTT)

18285 HYDRODYNAMIC STABILITY OF THE VELOCITY-GRADIENT FLOW IN A TRANSVERSE MAGNETIC FIELD OF A CONDUCTING LIQUID WITH EXPONENTIAL RHEOLOGICAL LAW. Martinson, L. K.; Pavlov, K. B.; Simkhovich, S. L. Magn. Gidrodin.; No. 2, 35-40(1972). (In Russian).

The hydrodynamic stability of the MHD flow of conducting Newtonian fluid with respect to infinitely small two-dimensional perturbations was investigated. The stationary Hartmann flow was examined in a channel with a transverse uniform magnetic field, letting the isotropically conducting, noncompressible rheological-fluid move in a plane channel under a constant pressure gradient. The external magnetic field was applied perpendicularly with respect to the nonconducting wall of the channel while the constant electric field was applied along the z axis. The neutral stability waves were derived for several values of these parameters. (TTT)

18286 PERISTALTIC FLOW OF A CONDUCTING FLUID IN A TRANSVERSE MAGNETIC FIELD. Vishnyakov, V. I.; Pavlov, K. B. Magn. Gidrodin.; No. 2, 41-45(1972). (In Russian).

The MHD flow of a fluid in a channel with elastic-rhythmically contracting walls is of great interest for the study of certain conducting physiological solutions, such as blood and for the theory of peristaltic MHD compressors. For this reason, the flow of a conducting Newtonian liquid in an infinite-slotted channel was examined. The deformation of the elastic walls was described by traveling wave equation; the length of the channel exceeded considerably the diameter while the transversal magnetic field was kept constant. The narrow-band asymptotic law was used to solve the problem, determining the velocity profiles at various cross-sections of the channel in order to obtain the desired parameters. As an example, the derived equation was applied for the case in which the deformation of the elastic walls without axial disturbance may be described by a monochromatic wave. (TTT)

18287 FREE CONVECTION IN A CONDUCTING FLUID JET ADJACENT TO A WALL. Ermolaeva, G. K.; Zhivov, M. Z.; Sokovishin, Yu. A. Magn. Gidrodin.; No. 2, 46-48(1972). (In Russian).

The convective heat exchange of conductive-fluid jet, flowing upward from a slot source along a sheet, was investigated while an external source was applied in the transversal direction with respect to the surface of the wall. The temperature difference between the jet gas and the surrounding medium created an Archimedean force which affected the jet strongly. A suitable transformation was used to integrate the differential equations by the finite difference method. Analysis of the obtained curves helped to clarify the effect of the flow on the velocity distribution, temperature, friction forces and heat transfer coefficients. The effect of the criteria Pr and k which indicate the relation between the free convection force and the electrodynamic force on the flow was also investigated. It was found that at the section at which the friction reaches a minimum, the flow changes, losing its jet-like character and becoming freely convective. (TTT)

18288 HEAT EXCHANGE OF A VERTICAL PLATE IN A LONGITUDINAL MAGNETIC FIELD. Zhivov, M. Z.; Sokovishin, Yu. A. Magn. Gidrodin.; No. 2, 49-52(1972). (In Russian).

The convective heat exchange on a vertical, electrically insulated plate placed in a conducting fluid within a longitudinal magnetic field was investigated by applying a potential difference at the ends of the plate, thus creating a current within it. The second-order magnetohydrodynamic boundary layer was studied, integrating the derived equations. In view of the large number of parameters, the computation was restricted to a few specific values, studying in particular the influence of free convection on the heat exchange process. The results indicated that if the free and forced convection act simultaneously, the heat exchange is intensified; in the opposite case, it is decreased. However, no inverse heat flux is observed along the plate in the latter case because the hydrodynamic boundary layer is removed. (TTT)

18289 ELECTRIC FIELD OF A FLUID IN A TRANSVERSE NONUNIFORM MAGNETIC FIELD. Fiks, I. G. Magn. Gidrodin.; No. 2, 53-58(1972). (In Russian).

The distribution of an electric field within a circular cross-section MHD channel with a nonuniform magnetic field was examined. The boundary case was solved for an ionically conducting isotropic fluid, considering specifically the influence of the position of the magnetic field sources within and without the channel. A method was developed to measure the velocities prevailing within large ducts by means of built-in electromagnetic transducers. As in large ducts the fluids are under turbulent flow conditions with high Reynolds numbers, turbulent flow was chosen for the study. It was found that the sensitivity at a transducer within an external magnetic field may be increased by placing hollow or full cylinders within the winding, thereby amplifying the magnetic field 1.5 to 1.7 times without distorting it. (TTT)

18290 ELLIPTIC JETS. Shcherbinin, E. V. Magn. Gidrodin.; No. 2, 59-67(1972). (In Russian).

Following up M. H. Steiger and M. H. Bloom's theoretical findings on the velocity distribution of jets, the effect of a magnetic field on the velocity gradient was further investigated in a transverse magnetic field by examining the spatial jet flow in an elliptic cross-section. It was shown that a jet with any given initial velocity profile degenerates into an elliptic velocity distribution, becoming elongated in the direction of the magnetic field. The jet undergoes algebraic damping, involving the increase of the MHD interaction in contrast to the exponential damping of plane jets. The results have generalized applicability beyond jet flow conditions, involving perturbation of the velocity field in a magnetic field at low Re_m values. (TTT)

18291 NONSTEADY-STATE FLOW OF A REAL CONDUCTING GAS IN AN MHD CHANNEL WITH MASSIVE ELECTRODES.

Bertinov, A. I.; But, D. A.; Kovalev, L. K.; Koneev, S. M. Magn. Gidrodin.; No. 2, 75-81(1972). (In Russian).

The one-dimensional flow of a real conducting gas in linear and coaxial MHD channels with a transverse magnetic field surrounded by a nonmagnetic medium was investigated. It was assumed that the MHD interaction parameter S and the magnetic Reynolds number R_m were large. The Hall effect was taken into account on the basis of the reduction of the transverse conductivity of the gas. In the case studied, the electrical field was characterized by the fact that the electromagnetic induction of the internal circuit in the channel was much lower than the field resulting from the external circuit. The nonsteady-state flow processes in the channel caused by changes of the magnetic field, Reynolds numbers and the conductivity were examined. Equations were derived to calculate nonsteady-state processes in both linear and coaxial channels. The cases examined included use of the excitation winding in a serial or parallel coupling. Transient processes taking place in a constant cross-section linear channel were investigated at various S and R_m values. (TTT)

18292 LOAD CHARACTERISTICS OF AN MHD CHANNEL IN THE CASE OF OPTIMUM DISTRIBUTION OF THE SPECIFIC RESISTIVITY IN THE WORKING BODY. Lur'e, K. A.; Simkina, T. Yu. Magn. Gidrodin.; No. 2, 82-90(1972). (In Russian).

An MHD channel with its terminal electrodes in an external field was studied; the field decreased uniformly to zero beyond the boundaries of the electrode area. The optimum resistance of the working substance in the channel was described by a symmetric tensor; one of the main values of the tensor is infinitely large while the other was equal to σ_{min}. The qualitative characteristic of the dependence of the current at the electrodes in case of the optimum distribution of the specific resistivity on the external load was derived using a computer program to obtain a numerical solution of the problem. Comparison was made with a channel filled with a constant σ_{min} specific-resistivity material, and a method was developed to approximate the optimum conditions by introducing thin nonconducting partitions into the channel. (TTT)

18293 ELECTRIC FIELDS IN MHD CHANNELS IN CASES OF ANISOTROPIC AND NONUNIFORM CONDUCTIVITY. Emets, Yu. P. Magn. Gidrodin.; No. 2, 91-96(1972). (In Russian).

Determination of the current distribution in anisotropically conducting media is complicated by nonuniformities which may be concentrated at the boundary or distributed within the medium. Because of the strong temperature dependence of the conductivity or the nonuniform distribution of slightly ionized materials, electric fields generated by continuously changing parameters of the medium have not yet been closely studied. For this reason calculations were carried out on the two-dimensional problem concerning the current distribution in MHD channels involving nonuniform-conductivity Hall effect in the plasma. The equations derived were integrated using the continuous group transform theory. (TTT)

18294 MAGNETIC WEIGHT FUNCTIONS FOR A CONDUCTION-TYPE MHD CHANNEL IN A STATIC REGIME. Grinberg, G. Magn. Gidrodin.; No. 2, 127-130(1972). (In Russian).

In view of the absence of detailed studies on MHD transducers, a theory was developed for a specific model. It was attempted to optimize the magnetization system of conduction-type MHD transducers by using the so-called magnetic weight functions. Several such functions were calculated, postulating an MHD channel under static conditions with the length of the electrodes equal to the width of the channel. The magnetic weight functions indicate the contribution of a magnetic charge or magnetic dipole to the MHD process or the specific contribution to the effective component of the electrodynamic force in the operating zone of the channel. These functions may be used to design optimized magnetization systems for conduction-type MHD channels. Any ion-containing portion may be replaced by a certain distribution of magnetic charges; on the other hand, the ion-free circuit may be replaced by a specifically arranged system of magnetic dipoles. (TTT)

18295 METHOD TO INCREASE THE ACCURACY OF THE NUMERICAL COMPUTATION OF THE NONSTEADY FLOW OF A CONDUCTING GAS IN A FARADAY-TYPE MHD CHANNEL. Korotkov, B. A. Magn. Gidrodin.; No. 2, 142-143(1972). (In Russian).

A computational method was developed to determine the MHD equations in the quasi one-dimensional approximation for conducting gases flowing at subsonic velocities. The approximation was based on the assumption that all parameters are unchanged. This method was improved, increasing the accuracy by using parameter values not at the end but in the middle of the segments. A device previously described in the literature was recalculated to illustrate the efficiency of the proposed method. The results revealed that the improved computing technique reduced the errors requiring less machine time. (TTT)

18296 EFFECT OF CROSSED ELECTRIC AND MAGNETIC FIELDS ON TWO-PHASE FLOW. Bolonov, N. I.; Dobrychenko, V. M.; Povkh, I. L.; Smirnov, V. A.; Chekin, B. V. Magn. Gidrodin.; No. 2, 146-148(1972). (In Russian).

The MHD separation method was used to enrich and to concentrate mineral products, to remove nonmetallic inclusions from liquid metals, and to leach metals from the slag in metallurgical operations. It is of interest to know the laws governing the flow of multiple phase streams in these operations. For this reason the velocity and concentration profile of a two-phase stream in an MHD separator channel was investigated, varying the electromagnetic force, the size, density and concentration of the particle and average flow rate. It was found that increase of the average flow rate tends to equalize the average particle concentration resulting from the increase of the intensity of turbulent pulses. The results may be used for the design of MHD separators. (TTT)

18297 HALL EFFECT IN A PLASMA STEAM IN THE PRESENCE OF A TRAVELING MAGNETIC FIELD. Rashchepkin, A. P. Magn. Gidrodin.; No. 2, 68-74(1972). (In Russian).

The effect of the anisotropic nature of the electric conductivity on electromagnetic processes in a plasma stream was investigated. The plasma was flowing through a rectangular channel with insulated walls within a traveling magnetic field. It was found that just like in a constant field, constant Hall potentials and currents are generated together with multiple frequencies. An approximate expression was derived to describe induction in the plasma; it was used to study the effect of the Hall parameter on the higher field harmonics, Hall currents and potentials. It was shown that by changing the level and direction of the Hall currents in the channels by means of a constant external source, it is possible to affect the degree of interaction of the plasma with the traveling magnetic field. Within the limits of tolerance, the anisotropy of the plasma's electric conductivity does not affect the energy transformation coefficient. This anisotropy results in an equivalent decrease of the electric conductivity of a reduction of its interaction with the traveling magnetic field. (TTT)

18298 MHD COUETTE FLOW BETWEEN CONDUCTING WALLS WITH HEAT TRANSFER. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Rev. Roum. Phys.; 17, No. 8, 947-953 (1972).

An analysis of a fully-developed MHD Couette flow of an electrically conducting, incompressible, viscous fluid between conducting walls is carried out when the magnetic field is applied transverse to the flow direction. Closed form solutions for the flow and energy field were derived in terms of M (Hartmann number) and I_1 (total current). An inverse in I_1 leads to an increase in B (induced magnetic field), $\{-Q\}$, (mass flow rate), θ (temperature), R τ (skin-friction) whereas Nu (Nusselt number) decreases with increasing I_1. At small I_1 and large M, there is a tendency of instability of the flow. (auth)

18299 EFFECT OF TRANSVERSE MAGNETIC FIELD ON AN INCOMPRESSIBLE CONDUCTING LAMINAR FLOW ALONG A VERTICAL WALL. Agarwal, H. L.; Ram, P. C. (Banaras Hindu Univ., India). Indian J. Phys.; 46: No. 7, 326-329(Jul 1972).

An analytical study is presented which describes the laminar accelerating flow of an incompressible conducting fluid running down a vertical wall under the influence of gravity and in presence of transverse magnetic field. The approximate mathematical solution is given, when surface tension is neglected. The result is one universal curve. (auth)

18300 STEADY FLOW OF A NONEQUILIBRIUM IONIZED GAS AROUND SHARP CORNERS IN THE PRESENCE OF A CROSSED MAGNETIC FIELD. Takahashi, T. (Tokyo Metropolitan Univ.). J. Phys. Soc. Jap.; 34: No. 1, 232-46(Jan 1973).

The steady flow of a nonequilibrium ionized gas with an infinite magnetic Reynolds number past an insulated wall with sharp corners, in the presence of a crossed applied magnetic field, is studied in the linearized approximation. The speed of the flow is assumed to be larger than that of the fast magnetohydrodynamic wave, and then the fundamental equation becomes purely hyperbolic, while the magnetic field in the wall is governed by the Laplace equation. Since the magnetic field should be continuous on the surface of the wall, disturbances propagate upstream of the first corner through the wall, and there is no uniform region in the flow field. In this case, the Laplace transform cannot be used and the Fourier transform is adopted. (auth)

18301 ANNUAL REVIEW OF FLUID MECHANICS. VOLUME 5. Van Dyke, M.; Vincenti, W. G. Palo Alto, CA; Annual Reviews, Inc. (1973). 450p. $10.00.

An abstract was prepared for one of the included papers on gasdynamics of explosions. The remaining papers were not in the scope of NSA and were omitted. (MOW)

For an abstract of an individual paper see: 18905.

18302 ROTATION OF A PARABOLOID IN A CONDUCTING FLUID. Ranger, K. B. (Univ. of Toronto). Appl. Sci. Res. (The Hague); 27: No. 1, 14-18(Oct 1972).

An exact solution is found for a rotating paraboloid of revolution in a viscous conducting fluid, and in the presence of a uniform aligned magnetic field. (auth)

18303 TWO-PHASE FLOW IN A DUCT OF CONSTANT CROSS SECTION (QUALITATIVE STUDY). Vulis, L. A.; Gusika, P. L.; Zhizhin, G. V. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 143-156(1972). (In Russian).

A detailed qualitative investigation of a one-dimensional steady-state flow of an ideal gas with entrained solid particles was completed with the aid of a three-dimensional phase diagram. Using this analysis, the character of a flow and accompanying processes of momentum exchange and energy changes between phases may be determined. This method is applicable to plane and three-dimensional phase diagrams, and to problems of gas dynamics such as MHD and EHD quasi-one-dimensional flows, and flows with ionization and dissociation processes. (KSW)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 18347.

18304 INVESTIGATIONS OF HIGH-ENERGY INTERACTIONS IN COSMIC RAYS. Allkofer, O. C. (Christian-Albrechts-Univ., Kiel). Atomkernenergie; 20: No. 3, 173-178(Dec 1972). (In German).

The essential results in the field of cosmic rays are presented which have been performed in the last 10 years by a research group of the Institut für Reine und Angewandte Kernphysik of the University Kiel. The investigations have been performed in the field of geophysics, biophysics, and high energy physics. Furthermore the momentary activities and future plans are discussed. (auth)

18305 SIMPLIFIED PROCEDURES FOR TESTING THE UNIFORMITY OF AN ANGULAR DISTRIBUTION. Anghelescu, D. (Polytechnic Inst., Bucharest). Stud. Cercet. Fiz.; 24: No. 8, 929-933(1972). (In Rumanian).

Simplified procedures for testing a uniform angular distribution in many-prong events are presented and discussed. They are based on the different distributions obeyed by the ordered successive angles. (4 tables) (auth)

Electromagnetic

18306 (UCLA-10-P-25-3(Rev.)) MEASUREMENT OF RADIATIVE PION-PROTON SCATTERING CROSS SECTIONS ABOVE THE Δ(1236) RESONANCE. Arman, M.; Blasberg, D. J.; Haddock, R. P.; Leung, K. C.; Nefkens, B. M. K.; Schrock, B. L.; Sober, D. E.; Sperinde, J. M. (California Univ., Los Angeles, Dept. of Physics). Sep 1972. Contract AT(11-1)-Gen-10. 24p. (CONF-720954-12). Dep. NTIS.

We have measured the differential cross section for radiative π^+-proton scattering, $\pi^+p \to \pi^+p\gamma$, at 294 MeV under kinematical conditions favorable to the observation of magnetic dipole moment radiation from the $\Delta^{++}(1236)$ resonance. For radiated photon energies above 30 MeV, our data do not agree with explicit theoretical calculations which include an estimate of the magnetic moment radiation. Rather, our data agree with the simple expression $d^5\sigma/(d\tilde{\Omega}_\pi d\tilde{\Omega}_\gamma d\tilde{E}_\gamma) = \sigma_0/\tilde{E}_\gamma$, over the full range of photon energy, up to $\tilde{E}_\gamma$ = 120 MeV (the ~ denotes a c.m. variable). Measurements of radiative π^--proton scattering have also been made. (auth)

18307 COSMIC RAYS AT MANCHESTER AND DURHAM. Rochester, G. D.; Wolfendale, A. W. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 99-114(1972).

A tribute is given to L. Janossy on the occasion of his 60th birthday, from the description of some of the experiments at Manchester with which he was associated and later work in the same field at Durham. The Manchester work covered a wide range of studies of showers, including electron-photon cascades and penetrating showers produced both by charged and neutral particles. Geiger counters were used as detectors and sophisticated arrangements were used to elucidate the shower characteristics and distinguish between the various types. Comparison with theory led to many important conclusions. Technical innovations, in the form of neon flash-tubes and solid iron magnets, were used at Durham. An account is given of their use in studies of muons, extensive air showers, neutrinos and the search for quarks. (auth)

18308 STUDY OF ELECTROMAGNETIC PROCESSES AT 1 GeV/c IN A HYDROGEN BUBBLE CHAMBER AND PRODUCTION-RATE LIMITS FOR NEW LOW-MASS PARTICLES. Ansorge, R. E.; Baker, R. D.; Krzesinski, A. E. S.; (and others) (Cavendish Lab., Cambridge, Eng.). Phys. Rev., D; 7: No. 1, 26-35(1 Jan 1973).

The Bethe-Heitler theory of pair production by photons and of bremsstrahlung by electrons is compared with observations of these processes in a liquid-hydrogen bubble chamber. Agreement between theory and experiment is found within the statistical limits of the experiment which are typically ~½% of the total cross sections studied. The form of the experiment also allows limits to be set on the production of new particles of mass less than 100 MeV in high-energy hadronic collisions. (auth)

18309 ANGULAR DISTRIBUTIONS OF THE ASYMMETRY OF THE REACTION $\gamma p \to \pi^0 p$ AT γ-QUANTUM ENERGIES 250, 300, AND 350 MeV. Ganenko, V. B.; Gorbenko, V. G.; Zhebrovskii, Yu. V.; (and others) (Physical-Technical Inst., Kharkov). JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 325-327(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 459-462(Oct 1972).

The results of measurements of the angular distribution of the cross section asymmetry for the reaction $\gamma + p \to p + \pi^0$ at 250 to 350 MeV are presented. (JFP)

18310 PHOTOPRODUCTION OF π MESONS FROM THE ^{12}C NUCLEUS BY 250 TO 1200 MeV PHOTONS. Goncharov, N. V.; Derebchinskii, A. I.; Konovalov, O. G.; Tonapetyan, S. G.; Khvorostyan, V. M. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 64: No. 1, 67-72(Jan 1973). (In Russian).

The energy spectra of charged π mesons produced in interaction between ^{12}C nuclei and photons with energies E_γ^{max} = 250 to 1200 MeV are obtained. Pions with kinetic energies E_π = 30 to 120 MeV are recorded at an angle of 90° with a freon bubble chamber. The dependence of $(d\sigma/d\Omega)_{90°}$ on photon energy is obtained for π^+ and π^--mesons and their sum by the photon difference technique. The experimental values of the $\pi^\pm$ meson production differential cross sections for ^{12}C nucleons agree with the calculated values for energies E_γ = 264 MeV and E_γ = 335 MeV. It is concluded that photoproduction of pions from ^{12}C nuclei involves all nucleons of the nucleus. (auth)

Weak

18311 FURTHER MEASUREMENT ON THE K_L-K_S REGENERATION AMPLITUDE ON HYDROGEN AT HIGH ENERGIES. Dubna-Serpukhov-Budapest Collaboration. Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 141-7(1972).

The transmission regeneration amplitude of the long-lived K mesons was measured in the 14 to 42 GeV energy range. The phase of the difference of the forward scattering amplitudes, arg (f−f), turned out to be (−118 ± 13)°, whereas its module over the kaon momentum, |f−f|/p, fell with increasing energy. (auth)

18312 MEASUREMENT OF THE BRANCHING RATIOS $(K_L^0 \to \pi\mu\nu)/(K_L^0 \to \pi e\nu)$ AND $(K_L^0 \to \pi^+\pi^-\pi^0)/(K_L^0 \to$ ALL CHARGED) USING A HEAVY-LIQUID BUBBLE CHAMBER. Evans, G. R. (Univ. of Edinburgh); Muir, J.; Peach, K. J.; (and others). Phys. Rev., D; 7: No. 1, 36-55(1 Jan 1973).

More than 4000 examples of K_L^0 charged decays were observed in a heavy-liquid bubble chamber. The branching ratios were measured to be $R_1 = (K_L^0 \to \pi\mu\nu)/(K_L^0 \to \pi e\nu) = 0.662 \pm 0.030$ and $R_2 = (K_L^0 \to \pi^+\pi^-\pi^0)/(K_L^0 \to$ all charged modes) $= 0.159 \pm 0.010$. (auth)

18313 EXPERIMENTAL RESULTS ON NEUTRON PRODUCTION BY MUONS AT 4300 MWE. Bergamasco, L.; Costa, S.; Picchi, P. (CNR, Turin). Nuovo Cim. 13A: No. 2, 403-412 (21 Jan 1973).

An experiment on neutron production by cosmic-ray muons has been carried out at the depth of 4300 MW(e). The target is a 35 cm layer of Pb and the neutron detector with twenty-eight BF_3 counters has an average efficiency of $2 \cdot 10^{-3}$. The results on the muon interaction cross section $\bar{m}\sigma$ and on the mean multiplicity at production $\bar{m}$ are compared with other data at lower energies (magnetic spectrographs and underrock) and with the expectation from the conventional nuclear and electromagnetic processes of muons of mean energy (250 to 300) GeV. (auth)

Strong (Baryon-induced)

Refer also to abstracts 17425 and 18653.

18314 (ANL/HEP-7245) NEUTRAL-STRANGE PARTICLE PRODUCTION IN 205-GeV PP INTERACTIONS. Charlton, G.; Voyvodic, L.; Crawley, H.B.; (and others) (Argonne National Lab., Ill; National Accelerator Lab., Batavia, Ill; Ames Lab., Iowa). 1972. 12p. (CONF 720954-16). Dep. NTIS. From 16th International Conference on High Energy Physics; Batavia, Illinois, United States of America (USA) (6 Sep 1972).

A bubble chamber study of proton-proton interactions at 205 GeV yielded 66K°, 28Λ and 2$\bar{\Lambda}$ produced in the backward CM hemisphere. The cross sections for $pp \to (\Lambda/\Sigma^\circ)$ + anything and $pp \to (K^\circ/\bar{K}^\circ)$ + anything are 3.2 ± 0.6 and 12.9 ± 1.7 mb, respectively. Comparison with lower energy data shows that (Λ/Σ°) production is consistent with approximate scaling behavior above 28 GeV, whereas the $(K^\circ/\bar{K}^\circ)$ invariant cross section has increased considerably between 28 and 205 GeV. (auth)

18315 (DESY-72/69) ANALYSIS OF THE REACTION $pp \to p(\pi\pi)^0p$, AND THE QUESTION OF DOUBLE-POMERON EXCHANGE

IN HIGH-ENERGY PRODUCTION PROCESSES. Idschok, U.; Kobe, P.; Selonke, F.; (and others) (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Nov 1972. 12p. Dep. NTIS (U. S. Sales Only).

A low-mass S-wave $(\pi\pi)^0$ enhancement is observed in the reaction $pp \rightarrow p(\pi\pi)^0p$ at 12 and 24 GeV/c incident momentum. The mechanism for producing these low-mass pion pairs is investigated, and it is shown that double-pomeron exchange can contribute at most 5% to their production cross section at 24 GeV/c. (auth)

18316 (JINR-P1-6811) SLOPE PARAMETER OF ELASTIC p–p SCATTERING IN THE COULOMB INTERFERENCE REGION. Chernev, H. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

Based on the analysis of the last experimental results the dependence of the slope parameter of elastic p-p scattering differential cross section on the variables s and t at energies higher than 10 GeV is considered. A conclusion is drawn that the slope parameter has different values in the region lower and higher than 0.013 $(GeV/c)^2$. (auth)

18317 NUCLEAR INTERACTIONS AT VERY HIGH ENERGIES. McCusker, C. B. A. (Univ. of Sydney). pp 138-43 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

Research on cosmic particle reactions with nuclei at very high energies is summarized. (JFP)

18318 INVESTIGATION OF MULTIBARYONIC RESONANCES WITH STRANGENESS EQUAL TO AND DIFFERENT FROM ZERO. Shahbazyan, B. A.; Timonina, A. A.; Kalinina, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Lett. Nuovo Cim.; 6: No. 2. 63-72(13 Jan 1973).

A propane bubble chamber was exposed to a 7.07-GeV/c neutron beam and a 4.0 GeV/c π^- beam in order to study the role which the total hypercharge and strangeness of a system play in the strong interactions of hadrons. To this end the interactions between two and more baryons were studied for two groups of them differing in total strangeness and hypercharge. For this purpose multibaryonic resonances were searched for and investigated using the study of the effective mass spectra of the studied systems. It was found that the candidates for resonances were observed only for systems of hypercharges not exceeding one. The hypothesis is formulated that the inequality that Y is equal to or exceeds 1 would be a necessary but not sufficient condition for the formation of hadronic resonances (if no resonances of widths $\Gamma \ll 1.0$ MeV do exist in hadronic systems of hypercharges $Y > 1$). (JFP)

18319 NEW DETERMINATION OF THE BINDING-ENERGY VALUES OF THE LIGHT HYPERNUCLEI ($A \leq 15$). Juric, M. (Inst. of Physics, Belgrade); Bohm, G.; Klabuhn, J.; (and others). Nucl. Phys.; B52: No. 1, 1-30(1973).

A new determination of the binding-energy values of the light hypernuclei ($A \leq 15$) is reported, based on the analysis of some 27,000 π^- mesonically-decaying hypernuclei produced by stopping K^- mesons in nuclear emulsion. The results are combined with previous data obtained using similar experimental and analytical procedures. (auth)

18320 STUDY OF $\pi^-\pi^-$ CORRELATIONS IN THE REACTION $pp \rightarrow \pi^-\pi^-$ ANYTHING AT 28.5 GeV/c. Hanlon, J.; Panvini, R. S.; Sims, W. H. (Vanderbilt Univ., Nashville). Nucl. Phys.; B52: No. 1, 96-108(1973).

Correlations between $\pi^-\pi^-$ pairs are studied in the reaction $pp \rightarrow \pi^-\pi^-$ + anything at 28.5 GeV/c. It is found that if one examines the data for each multiplicity separately, the major portion of the data (90%) shows no significant two-particle correlations. (auth)

18321 EXCHANGE MODEL ANALYSIS OF THE REACTIONS $pp \rightarrow pn\pi^+$ and $pp \rightarrow pp\pi^+\pi^-$ AT 12 GeV/c. Bonn–Hamburg–Munich Collaboration. Nucl. Phys.; B52: No. 1, 109-125(1973).

New data are presented for the reactions $pp \rightarrow pn\pi^+$ and $pp \rightarrow pp\pi^+\pi^-$ at 12 GeV/c. An attempt is made to understand various features of the data in terms of three one-pion-exchange models, namely the elementary one-pion-exchange (OPE) model in the version of Wolf, a Reggeized pion-exchange (RPE) model and the double-Regge-pole (DRP) model in the version of Berger. The predictions from these models are compared with several distributions of invariant masses, momentum-transfers, Treiman–Yang and Gottfried–Jackson angles. The Regge models are able to describe the gross features of these distributions better than the OPE model, although they are not capable of reproducing all details. (auth)

18322 CHARGE EXCHANGE $\bar{p}p \rightarrow \bar{n}n$ AT 5.0 AND 7.76 GeV/c NEAR THE FORWARD DIRECTION. Lee, J. G. (Imperial Coll. of Science and Tech., London); Harckham, A.; Letheren, M.; (and others). Nucl. Phys., B52: No. 1, 292-300(1973).

The differential cross section for the charge exchange $\bar{p}p \rightarrow \bar{n}n$ has been measured with high statistics at 7.76 and at 5.0 GeV/c. The 7.76 GeV/c data show a very narrow $[\Delta t \lesssim 0.01\ (GeV/c)^2]$ forward peak superposed on a slow exponential fall-off. (auth)

18323 ONE-PION-EXCHANGE ANALYSIS OF THE REACTION $np \rightarrow pp\pi^-$ FROM 1.5 TO 4.0 GeV/c INCIDENT MOMENTUM. Alexander, G. (Univ. of Tel-Aviv, Israel); Benary, O.; Dagan, S.; (and others). Nucl. Phys.; B52: No. 1, 221-238(1973).

The reaction $np \rightarrow pp\pi^-$ was studied in the incident-momentum range of 1 to 4 GeV/c using the DESY 85-cm HBC exposed to a neutron beam. The production of $\Delta(1236)$ and other baryon states is examined. The reaction is analyzed in terms of a one-pion-exchange model using the Dürr–Pilkuhn and Benecke–Dürr parametrizations. Taking Wolf's set of R parameters, apart from R_Δ which was set to 1 GeV^{-1}, an adequate description of all features of the data is obtained. The quantity $\sigma(np \rightarrow pp\pi^-)$ as function of the neutron momentum is evaluated using the OPE model and the isospin relation between the Δ production in np and pp reactions. (auth)

18324 ELASTIC ANTIPROTON–DEUTERON SCATTERING BELOW 1.0 GeV/c. Caro, D. E.; Gold, E.; Klein, A. G.; (and others) (Univ. of Melbourne). Nucl. Phys.; B52: No. 1, 239-247 (1973).

Differential cross sections for elastic $\bar{p}d$ scattering at beam momenta 0.735 and 0.940 GeV/c and momentum transfers in the range $0.04 < |t| < 0.5\ (GeV/c)^2$ are presented. The $\bar{p}d$ elastic differential cross section is expressed in terms of a deuteron form factor and the I = 0 t-channel exchange $\bar{N}N$ amplitudes, enabling one to isolate the corresponding I = 0 t-channel exchange cross sections. (auth)

18325 BACKWARD PEAKS IN MESON–BARYON AND BARYON–ANTIBARYON INTERACTIONS AT HIGH ENERGY. Eskreys, A. (Inst. of Nuclear Physics, Krakow). Zesz. Nauk. Uniw. Jagiellon., No. 231, Pr. Fiz.; No. 8, 65-82(1970).

A review is given of the experimental evidence for backward peaks which appear in the two-body or quasi-two-body reactions initiated by mesons or antibaryons on baryon targets at 2 to 20 GeV/c. The evidence for the existence and energy and μ dependence of backward peaks and polarization effects are discussed. (JFP)

18326 MULTIPLICITIES OF CHARGED PARTICLES UP TO ISR ENERGIES. Antinucci, M. (Univ. Bologna); Bertin, A.; Capiluppi, P.; (and others). Lett. Nuovo Cim.; 6: No. 4, 121-128 (27 Jan 1973).

The determination of the average multiplicity for single particles produced in proton-proton collisions is reported. The method of integrating single-particle spectra was applied to the following inclusive processes: $pp \rightarrow \pi^\pm + X$, $pp \rightarrow K^\pm + X$, and $pp \rightarrow p^\pm + X$. The results of the calculations are given for ISR data as well as for other data at lower energies. The energy dependence of the average multiplicities is also presented and discussed. (LBS)

18327 EXISTENCE OF PARTICLES HAVING MASSES INTERMEDIATE BETWEEN ELECTRONS AND MUONS. Virk, H. S. (Univ., Paris). Compt. Rend., Ser. B; 275: No. 19, 709-711 (6 Nov 1972). (In French).

Relativistic particles emitted in white stars produced by proton-nucleon interactions at 14 GeV in nuclear emulsions were studied. Particles having masses intermediate between electrons and muons were not observed. These results are in contradiction with results of other workers. (France)

18328 EXISTENCE OF THE FRAGMENTATION REGION. Shen, M. L. (Tusculum Coll., Greeneville, TN). Nuovo Cim.; 13A: No. 2, 397-402(21 Jan 1973).

Inclusive log tg ψ spectra from multiparticle production in p-p collisions at 28.5 GeV from bubble chamber data are compared with 28.5 GeV p-N, 60 GeV π^--N, ~400 GeV cosmic ray and ~3000 GeV cosmic-ray emulsion data to demonstrate the existence of the fragmentation region. (auth)

Strong (Meson-induced)

Refer also to abstract 18466.

18329 (CEA-N-1577) STUDY OF MULTIPLE PRODUCTION SIX AND SEVEN BODY REACTIONS IN π^-p INTERACTIONS AT 11 GeV/c. Daronian, P. (Commissariat a L'Energie Atomique, Saclay (France). Centre D'Etudes Nucleaires). Nov. 1972. 134p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Final states with six and seven bodies in 11 GeV/c π^-p interactions were studied in a bubble chamber experiment. Dynamic effects such as peripherism and the leading effect were observed. Resonance production (Δ^{++} and ρ^0 mainly) is important; diffraction-like mechanism represents about thirty percent of the total number of events. The distributions of the secondaries are well reproduced by the prediction of a multi-Regge model. (France)

18330 (DESY-72/63) PROPERTIES OF THE B MESON OBSERVED IN 11 GeV/c $\pi^\pm$p INTERACTIONS. Afzal, M.; Bassfer, E.; Calligarich, E.; (and others) (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Nov 1972. 25p. Dep. NTIS (U. S. Sales Only).

Production and decay properties of the B meson are studied in the reactions $\pi^\pm p \rightarrow B^\pm p$ at 11 GeV/c. Values for mass, width, total and differential cross sections and spin density matrix elements are given. The spin and parity, and the helicity states in the $B \rightarrow \pi\omega$ decay, are analyzed. (auth)

18331 (JINR-E1-6599) INELASTIC INTERACTIONS OF PROTONS AND PIONS WITH EMULSION NUCLEI AT (45 TO 67) GeV/c. Dalkhazhav, N.; Shabratova, G. S.; Tolstov, K. D.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 8p. (CONF-720954-11). Dep. NTIS (U. S. Sales Only).

From 16th international conference on high energy physics; Batavia, IL (6 Sep 1972).

It is shown that the mean multiplicity of charged particles in inelastic collisions of π^--mesons and protons with protons, as a function of energy in c.m.s. follows the 0.66 law. The mean multiplicity of charged particles, which were generated in inelastic collisions of π^- and p with protons and neutrons, is presented. (auth)

18332 (JINR-E1-6851) NEUTRAL KAON REGENERATION IN THE MOMENTUM REGION OF 14 TO 50 GeV/c. Birulev, V. K.; Genchev, V.; Govorun, N. N.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 14p. (CONF-720954-15). Dep. NTIS (U. S. Sales Only).

From 16th International Conference on High Energy Physics; Batavia, Illinois, United States of America (USA) (6 Sep 1972).

The measurement results are presented for the neutral kaon regeneration amplitude in the momentum region 14 to 50 GeV/c. The results are compared with the calculations over Regge model and dispersion relations. (auth)

18333 (LBL-1370) STUDY OF THE REACTION $K^-p \rightarrow \Lambda\pi^0$ IN THE RESONANCE REGION BELOW 1.8 GeV/c: PARTIAL WAVE ANALYSIS, ZERO TRAJECTORIES, AND RESONANCE AMBIGUITIES. Van Horn, A. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Nov 1972. Contract W-7405-eng-48. 185p. Dep. NTIS.

Thesis.

An energy-dependent partial wave analysis of $K^-p \rightarrow \Lambda\pi^0$ has been performed between 1537 and 2215 MeV, including new data from this experiment between 1865 and 2106 MeV. The method of Barrelet zeros has been used to investigate the zeros of the transversity amplitude ($f \pm ig$) and to study partial wave ambiguities. Seven ambiguous solutions with identical χ^2 have been found which maintain the dominant Σ resonant structure [D3(1660), D5(1765), F5(1920), F7(2040)] but differ in the resonant couplings ($t = \sqrt{\Gamma_e\Gamma_r}/\Gamma$) for these states, as well as in the resonant structure in the lower partial waves. Evidence is given for the possible existence of new resonant states in the F5, D5, and F7 partial waves and for additional resonances in lower waves. Several solutions contain resonant "daughter" states at the same mass but with different J^P, suggestive of Veneziano models. The seven ambiguities are experimentally distinguishable only by measurement of $\tilde{R}$ and $\tilde{A}$, which are predicted from the solutions. Each solution has been shown to be consistent with semi-local duality from observed averaging about zero exhibited by Im[A'(s,t)], the invariant, t channel helicity non-flip amplitude calculated at $t = 0$ and at $t = m_K^2$*. Local averaging was not seen in B(s,t), the t channel helicity flip amplitude. The variation of resonant couplings found in different solutions for the dominant resonances suggests that SU(3) tests involving the $\Lambda\pi$ channel may need to be re-evaluated. The results also indicate that the possible ambiguities should be more carefully studied in other reactions. Experimental cross sections, angular distributions, and polarizations are presented for both reactions $K^-p \rightarrow \Lambda\pi^0$ and $K^-p \rightarrow \bar{K}^0n$ at 19 incident beam momenta in the center of mass energy range 1709 to 2106 MeV. Legendre polynomial expansion coefficients to seventh order are given for these data. The experimental procedures from this exposure in the Lawrence Berkeley Laboratory 25'' hydrogen bubble chamber are also discussed. (auth)

18334 (LNF-72/90) ANALYSIS OF THE DECAY MODES OF THE RHO'(1600) MESON. Ceradini, F.; Conversi, M.; D'Angelo, S.; (and others) (Comitato Nazionale Per L'Energia Nucleare, Frascati (Italy). Laboratori Nazionali Di Frascati.). 23 Oct 1972. 7p. Dep. NTIS (U. S. Sales Only).

An analysis of $\pi^+\pi^-\pi^+\pi^-$-events from e^+e^- annihilation, yields preliminary evidence for the decay scheme $\rho'(1600) \rightarrow \rho^0(760) + \epsilon^0(850)$. Assuming this decay scheme the ρ'-photon coupling constant $g_{\rho'\gamma} = em_{\rho'}^2/f_{\rho'}$ is evaluated; the value $f_{\rho'}^2/4\pi = 17 \pm 5$ was found. (auth)

18335 (UCLA-10-P-25-5(Rev.)) MEASUREMENT OF THE DIFFERENTIAL CROSS SECTIONS FOR RADIATIVE PION-PROTON CAPTURE IN THE FIRST RESONANCE REGION. Comiso, J. C.; Blasberg, D. J.; Haddock, R. P.; Nefkens, B. M. K.; Truoel, P.; Verhey, L. J. (California Univ., Los Angeles. Dept. of Physics). Sep 1972. Contract AT(11-1)-Gen-10. 32p. (CONF-720954-14). Dep. NTIS.

Differential and total cross sections were found for the reaction $\pi^- + p \rightarrow n + \gamma$ at 1.190 to 1.283 GeV in the first and second resonance region. The data suggest that the $\Delta(1236)$ plays a central role in producing the apparent T violation. (JFP)

18336 MASS OF THE NEUTRAL PION. Tangherlini, F. R. (Coll. of the Holy Cross, Worcester, MA). Lett. Nuovo Cim.; 5: No. 12, 829-33(18 Nov 1972).

A re-examination of the data for the neutral pion mass as given in the literature was made. This mass value was found to be 135.0143 MeV. It is concluded that a value for the neutral pion mass larger than the present one and close to theoretical estimates is empirically tenable and probable. Also the mass of the muon was recalculated using the value of the given neutral pion mass. The muon mass was found to be 105.6523 MeV. (JFP)

18337 COMPARISON OF THE REACTION $K^-p \rightarrow \Xi^-K^+$ WITH BACKWARD K^+p ELASTIC SCATTERING. Eisner, R. L.; Fields, R. D.; Chung, S. U.; Aguilar-Benitez, M. (Brookhaven National Lab., Upton, NY). Phys. Rev., D; 7: No. 1, 1-5(1 Jan 1973).

New data for the reaction $K^-p \rightarrow \Xi^-K^+$ at 3.9-, 4.6-, and 5.0-GeV/c incident momenta are presented. The behavior of $K^-p \rightarrow \Xi^-K^+$ is compared with $K^+p \rightarrow pK^+$ backward scattering using a simple model with Reggeized baryon exchange and SU(3). (auth)

18338 ANALYSIS OF $K^-p \rightarrow \Lambda\pi^+\pi^-$ IN THE REGION OF THE $\Lambda(1520)$. Mast, T. S.; Alston-Garnjost, M.; Bangerter, R. O.; (and others) (Univ. of California, Berkeley). Phys. Rev., D; 7: No. 1, 5-22(1 Jan 1973).

The rate for the decay $\Lambda(1520) \rightarrow \Sigma(1385)\pi$ was measured in a study of the reaction sequence $K^-p \rightarrow \Lambda(1520) \rightarrow \Sigma(1385)\pi \rightarrow \Lambda\pi^+\pi^-$. A sample of 9200 events of the type $K^-p \rightarrow \Lambda\pi^+\pi^-$ has been obtained in the Berkeley 25-in. hydrogen bubble chamber. The incident momenta range from 300 to 470 MeV/c. An energy-independent partial-wave analysis was performed using an isobar model. The model included a coherent mixture of six partial waves to describe all mass distributions, angular distributions, and the polarization of the Λ. The $\Sigma(1385)\pi$ decay mode was found to dominate the $\Lambda\pi^+\pi^-$ decay of the $\Lambda(1520)$, in disagreement with the results of a production reaction study of the same decay. The width for the decay was measured to be 1.40 ± 0.26 MeV. Mixing between the $\Lambda(1520)$ and the $\Lambda(1690)$ has been used in the past to describe the $J^P = 3/2^-$ baryons as SU(3) singlet and octet. Combining the rate for $\Lambda(1520)$ with a recently measured rate for $\Lambda(1690) \rightarrow \Sigma(1385)\pi$, the mixing angle $|\theta| = 63$ to $83°$ was calculated. This is in strong disagreement with the mixing angle derived from the two-body D-wave decays of the singlet and octet of $-25 \pm 6°$. Thus, some modification of the usual SU(3) description of these states needs to be made. (auth)

18339 K^+p AND K^+d TOTAL CROSS SECTIONS IN THE MOMENTUM RANGE 0.57 TO 1.16 GeV/c. Bowen, T. (Univ. of Arizona, Tucson); Jenkins, E. W.; Kalbach, R. M.; (and others). Phys. Rev., D; 7: No. 1, 22-26(1 Jan 1973).

K^+p and K^+d total cross sections were measured in the momentum range 0.57 to 1.16 GeV/c using a secondary, separated kaon beam of the Lawrence Berkeley Laboratory Bevatron and conventional transmission-counter techniques. No evidence was found for structure in the cross section of either reaction as previously indicated near 0.7 GeV/c. (auth)

18340 COHERENT PRODUCTION OF MULTIMESON FINAL STATES ON A ~ 20 NUCLEI BY K^- OF 5.5, 10.0, 12.7 GeV. Bingham, H. H. (Univ. of California, Berkeley); Farwell, C. W.; Fretter, W. B.; (and others). Nucl. Phys.; B52: No. 1, 31-69 (1973).

Coherent production of $\bar{K}\pi$, $\bar{K}2\pi$ and $\bar{K}3\pi$ final states from A ~ 20 nuclei by K^- beams of 5.5, 10.0 and 12.7 GeV is analyzed. Final states with $\leq 2\pi^0$ are included. Coherent $K\pi$ production occurs (although forbidden via 0^+ exchange) and is dominated by the $\bar{K}^*(890)$. The shape of the t distribution, the alignment of the pro-

duced meson and the ratio of the cross section on nuclei to that on hydrogen are consistent with optical model predictions assuming that $\bar{K}^*(890)$ are produced on single nucleons by exchange of isoscalar trajectories of natural parity ($J^P = 1^-, 2^+$, etc.) and that the $\bar{K}^*(890)$ absorption in nuclear matter equals that of the K^-. Coherent $\bar{K}\pi\pi$ production (allowed via 0^+, 1^-, 2^+, etc. exchange) is dominated by the Q phenomenon. A Dalitz plot and angular correlation analysis yields values for $\bar{K}\rho/\bar{K}^*\pi$ fractions, and shows that $J^P = 1^+$ S-wave $\bar{K}^*\pi$ dominates the coherently produced Q. The helicity of the Q is found to be compatible with 0. The Q^--nucleon total cross section is estimated to be $0.98^{+0.24}_{-0.31}$ times the K^--nucleon total cross section from a comparison of the coherent Q-production cross section with corresponding hydrogen cross sections at 10 and 12.7 GeV. Coherent production of $\bar{K}\omega$ is observed. The ratio $\bar{K}\omega/\bar{K}\pi\pi$ coherently produced in the Q mass region is (4 ± 1)%. Coherent production of $K^-\pi^+\pi^-$ and $\bar{K}^0\pi^+\pi^-\pi^0$ is observed in the L region. Coherent production is not observed in the $K4\pi$ channels. (auth)

18341 REMARKS ON AN S-WAVE $K\pi$ RESONANCE AT 1360 MeV. Yuta, H. (Argonne National Lab., IL); Engelmann, R.; Musgrave, B.; (and others). Nucl. Phys.; B52: No. 1, 70-76(1973).

The $\bar{K}^0\pi^-$ and $K^-\pi^+$ mass distributions obtained from a K^-p experiment at 5.5 GeV/c are used to study the recent suggestion of an s-wave $K\pi$ resonance at 1360 MeV. Using a model including $I = 3/2$ s- and p-wave and $I = 1/2$, s-, p- and d-wave amplitudes, the spherical harmonic moments $\langle Y_l^0 \rangle$ of the $K\pi$ decay angular distribution are analyzed in the $K^*(1420)$ mass region, and the result is obtained that the reported mass of 1360 MeV does not necessarily represent the resonance position and is influenced by cuts made in the $K\pi$ decay angle. (auth)

18342 THREE- AND FOUR-PION ANGULAR CORRELATIONS IN HIGH-MULTIPLICITY πp INTERACTIONS. Aachen–Berlin–Bonn–CERN–Krakow–Heidelberg–Warsaw Collaboration. Nucl. Phys.; B52: No. 1, 189-202(1973).

A new set of parameters is introduced to describe charge dependence of three- and four-pion correlations. An effect similar to the GGLP effect observed for pion pairs, but stronger, is found for three- and four-pion systems. This effect, however, can be interpreted as a reflection of the GGLP effect. (auth)

18343 TWO-PARTICLE INCLUSIVE REACTIONS IN 9 GeV/c K^-p COLLISIONS. Foster, M.; Quigg, C. (State Univ. of New York, Stony Brook). Phys. Rev., D; 7: No. 1, 108-114(1 Jan 1973).

Cross sections and correlation functions are presented for two-body inclusive channels in K^-p collisions. The cross sections for two particles emitted in the same hemisphere depend mainly on the variable $(x_1 + x_2)$, where $x_i \equiv p_\parallel^i/p_{max}^*$. Interpretations are given of the appreciable correlations which occur in addition to those imposed by momentum conservation. (auth)

18344 REDISTRIBUTION OF ENERGY AMONG GENERATED PARTICLES IN THE RANGE OF SEVERAL HUNDRED GeV's. Emel'yanov, Yu. A.; Eremenko, Yu. A.; Takibaev, Zh. S. (Inst. of High Energy Physics, Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 204: No. 4, 814-16(1 Jun 1972). (In Russian).

The behavior of different angular and energy characteristics was studied as a function of E_π, the energy communicated to all generated particles. The distribution of energy imparted to all secondary particles, among charged and neutral mesons, was the approach taken to the problem, and 80 events obtained with a carbon target were evaluated with respect to E_π. It was found that at energies up to $E_\pi \approx 300$ GeV neutral and charged particles carry roughly equal energies. At charged particle energies > 300 GeV these energies begin to be distributed unequally: E_{π^0} increases more rapidly than $E_{\pi^\pm}$ for an increase in E_π. (KSW)

18345 HIGH MULTIPLICITY INTERACTIONS. Czyzewski, O. (Inst. of Nuclear Physics, Krakow). Zesz. Nauk. Univ. Jagiellon., No. 231, Pr. Fiz.; No. 8, 37–63(1970).

A review is given of high multiplicity interactions covering cross sections and multiplicity distributions, properties of secondary particles averaged over all channels, general features of many-body processes, nucleon t distributions and the fireball model, the multi-Regge model, the average value of the longitudinal momentum and the relation between the multiperipheral and fireball models. (JFP)

18346 TEST OF POLE EXTRAPOLATION IN THE REACTION $\pi + p \rightarrow \rho^0\Delta^{++}$ AT 11.7 GeV/c. Caso, C. (Univ., Genoa); Conte, F.; Contri, R.; (and others). Nuovo Cim.; 13A: No. 2, 343-354 (21 Jan 1973).

In the reaction $\pi^+p \rightarrow \rho^0\Delta^{++}$ at 11.7 GeV/c, we have applied a pole extrapolation, using off-shell corrections as given by Benecke–Dürr, to obtain on-shell π^+p elastic-scattering cross sections. The extrapolation is also performed without using correction functions. Comparison of the results with the directly measured π^+p elastic cross section shows that the insertion of the form factor clearly improves the accuracy of the extrapolated results. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 19047.

General

Refer also to abstracts 18952 and 19045.

18347 (COO-1764-176) PROGRESS REPORT, SEPTEMBER 1, 1971–AUGUST 31, 1972. (Minnesota Univ., Minneapolis. Inst. of Tech.). 1972. AT(11-1)-1764. 29p. Dep. NTIS.

This report describes research in nuclear physics and elementary particle physics. The nuclear research is all theoretical, but the high energy research is both theoretical and experimental. The report is organized according to this three-way division of research activities. The reader is warned that some of the results presented here are tentative and may be modified before publication. (auth)

18348 (JINR-P2-6789) GROUP VELOCITY AND MACRO-CAUSALITY CONDITIONS FOR FORWARD SCATTERING AMPLITUDE. Lyuboshits, V. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 18p. (In Russian). Dep. NTIS (U.S. Sales Only).

Macrocausality conditions are formulated for the forward scattering amplitude based on the analysis of the wave packet distribution in macroscopic medium. In particular, it is shown that for the zero-mass particles the real part of the scattering amplitude at zero energy cannot be positive if the ratio $\mathrm{Ima}(\kappa)/\mathrm{Rea}(\kappa)$ tends to zero at $\kappa \rightarrow 0$. (auth)

18349 (UH–511-142-72) ANNUAL PROGRESS REPORT. Peterson, V. Z.; Pakvasa, S. (Hawaii Univ., Honolulu. Dept. of Physics and Astronomy.). 19 Oct 1972. Contract AT(04-3)-511. 110p. Dep. NTIS.

Experimental and theoretical research on high energy physics is summarized. A list of publications is included. (JFP)

18350 HIGHLY CHARGED SUBNUCLEAR PARTICLES. Yock, P. C. M. (Univ. of Auckland, New Zealand). pp 144-8 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

Some general aspects of the theory for the hypothetical, massive, highly charged subnucleons are discussed from an experimental point of view. The existence, binding mechanism, bound state combinations, and mass of these particles are discussed. (JFP)

18351 NEW APPROACH TO QUANTUM NUMBERS IN ELEMENTARY PARTICLE PHYSICS. Ramakrishnan, A. (Inst. of Mathematical Sciences, Madras). pp 150-6 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The treatment of the internal quantum numbers of quarks covers the generalized Clifford algebra, the generalized Gell-Mann–Nishijima relation, and the Dirac procedure for the generalized Clifford algebra. (JFP)

18352 REPRESENTATION OF BOSONS BY FERMIONS. Bopp, F. (Univ., Munich). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 95-8(1972).

Starting from the proposition that all quantum processes can be understood as a cooperation of a set of elementary processes (dichotomic processes), it is proven how Bose processes can be represented by an enumerable set of Fermi operators. (auth)

18353 UNITARITY BOUNDS ON ELASTIC CROSS-SECTIONS. Eftimiu, C. (Univ. of Missouri, St. Louis). Phys. Rev., D; 7: No. 1, 267-269(1 Jan 1973).

Necessary conditions to be satisfied by any elastic differential cross section are derived directly from the unitarity condition and compared with the Martin–Newton condition. Possible practical uses of these conditions are briefly indicated. (auth)

18354 NUCLEAR, PARTICLE, AND MANY BODY PHYSICS. Volume I. Morse, P. M.; Feld, B. T.; Feshbach, H.; Wilson, R. (eds.). New York; Academic Press, Inc. (1972). 710p. $23.00.

Papers dedicated to the memory of Amos de-Shalit are collected.

The topics treated include Coulomb lattices, dual resonance models, energy levels, hypernuclei, Schwarzschild solution, transition rates and multipole moments, doorway states, quark selection principle, form factors, symmetries for multiplet production $\pi + N$ scattering, $N - N$ correlations, angular momentum theory, excitations in liquid helium-4, weak interactions, and electron – nucleus scattering. Also covered are elastic hadronic processes, collective energies, boson structure, 0(2,1) expansion for asymptotically growing amplitudes, multi-particle spaces, negative specific heat, rigid motion, pion diffraction dissociation, Coulomb excitation of ^{197}Au, nuclear sum rules and exchange effects, deorientation measurement, quantum mechanics with constraints, Green function, electric-quadrupole isomers, magnetic-dipole states in near spherical nuclei, differential cross sections for exchange reactions, and ^{17}O and ^{41}Ca spectra. This material appeared previously in Annals of Physics. (JFP)

18355 LOCALIZABILITY AND SINGLE-PARTICLE EXCHANGE AMPLITUDES. II. Rivers, R. J. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B52: No. 1, 155-168 (1973).

Necessary causal constraints on the growth of coupling constants in a class of meromorphic amplitudes that can have good Regge-pole behavior are examined. Such necessary conditions are stronger than those proposed earlier for a simpler class of amplitudes. As an example it is shown that the Veneziano amplitude is acausal trajectory by trajectory. (auth)

18356 DISTRIBUTION WITH RESPECT TO THE TRANSVERSE MOMENTUM IN THE MULTIPERIPHERAL MODEL. Levin, E. M.; Ryskin, M. G. JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 353-356(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 495-499(20 Oct 1972).

The particle distributions with respect to the transverse momenta of the muons produced in collisions between two particles in the multiperipheral model are obtained. Good agreement with experiment is found. (JFP)

18357 INVERSE SCATTERING PROBLEM AT FIXED ENERGY FOR L^2-DEPENDENT POTENTIALS. Hooshyar, M. A. (Pahlavi Univ., Shiraz, Iran). J. Math. Phys. (N. Y.); 13: No. 12, 1931-1933(Dec 1972).

The problem of finding central and L^2-dependent potentials, acting among spinless particles, from the knowledge of the S matrix as a function of angular momentum at a fixed energy is studied. The Newton method for central potentials is generalized to this case, and it is shown that phase shift information at fixed energy is not enough to give us both the central and the L^2-dependent potential. (auth)

18358 SOLUTIONS OF A NONLINEAR INTEGRAL EQUATION FOR HIGH ENERGY SCATTERING. III. Analyticity of Solutions in a Parameter, Explored Numerically. Bart, G. R. (Mayfair Coll.; Chicago); Warnock, R. L. J. Math. Phys. (N.Y.); 13: No. 12, 1896-1902(Dec 1972).

Solutions of the Ball–Zachariasen equation, discussed in two previous papers, depend analytically on a parameter c which measures the strength of particle production. Numerical experiments, designed to elucidate the structure of the Riemann surface, are reported. The results are consistent with a very pretty hypothesis which describes the Riemann surface completely. (auth)

18359 FIELD THEORY WITH CONTINUOUS MASS SPECTRUM OF ASYMPTOTIC FIELD. Lukierski, J. (Univ., Wroclaw). Zesz. Nauk. Uniw. Jagiellon., No. 231, Pr. Fiz.; No. 8, 83-90 (1970).

The applicability of the field operators $\varphi(x, s)$, where s denotes the continuous values of asymptotic masses, to the description of composite systems is discussed. (auth)

18360 NUCLEAR, PARTICLE, AND MANY BODY PHYSICS. Volume II. Morse, P. M.; Feld, B. T.; Feshbach, H.; Wilson, R. (eds.). New York; Academic Press, Inc. (1972). 949p. $27.00.

Papers dedicated to the memory of Amos de-Shalit are collected. The topics covered include rational Lagrangian renormalization, nuclear high energy scattering, nuclear reactions, quartets in nuclei, nuclear energies, level densities and excitation strengths, potential scattering, particle unstable states, pion–nucleus optical potential, proton analog and compound state scattering, nonorthogonal orbitals, Compton scattering, deformed analog resonances, isomeric muonic atoms, light like distances, finite nuclear systems, NBC type apparatus, hadron collisions, separation energies, nuclear Josephson effect, coherent pion production, magnetic charge quantization, and ^{42}Sc level structure. Also covered are partons, core polarization and nucleon effective interactions in nucleus, baryon composite models, unique first- and third-forbidden beta decay, energy level in ^{206}Pb, transfer reactions, Sopkovich approximation, strangeness analog resonances, hadronic internal symmetry breaking, effective radius operator, dispersion effects on isotopic charge density, near-magic odd–odd nuclei spectra, neutron star quakes and pulsar speedup, current algebra, scaling in inelastic electron scattering, Fresnel diffraction in deuterium, transfer reactions, and quartet structures in the nickel region. This material appeared previously in Annals of Physics. (JFP)

18361 CONVERGENCE OF THE SUM RULES FOR CLUSTER FUNCTIONS IN A ϕ^3 LADDER MODEL. Bopp, F. W. (Univ. of Illinois, Urbana). Phys. Rev., D; 7: No. 2, 465-469(15 Jan 1973).

The convergence of the series in the sum rules of Campbell and Chang for cluster functions is investigated numerically for the ϕ^3 ladder model. It is found that in this model these sum rules diverge for a sufficiently large value of the coupling constant that the Pomeranchukon-Regge trajectory goes through $\alpha(0) = 1$. (auth)

18362 HIGH ENERGY PHYSICS INDEX. VOLUME 10, NO. 25, 1972. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 69p.

18363 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 1-2, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 56p.

18364 DERIVATION OF THE VIRASORO CONDITIONS IN THE STRING MODEL. Konisi, G. (Kwansei Gakuin Univ., Nishinomiya, Japan). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2008-2023(Dec 1972).

It is shown that the Virasoro conditions and the trajectory equation in the dual resonance model can be derived from the Lagrange coordinate condition in the Nambu-Susskind string model. The proof is based on a causality requirement concerning the vibrational waves on the string and on a Lagrangian theory of the free relativistic string with the ordinary time parameter. The case of interaction with an external scalar field is also discussed. (auth)

18365 GENERAL VERTEX WITH PHYSICAL EXCITED PARTICLES IN THE DUAL RESONANCE MODEL OF THE VIRASORO CASE. Sohkawa, T. (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2024-2043(Dec 1972).

We investigate the transformation properties of the asymmetrical general vertex of the dual resonance model under the projective group. We show that, in the Virasoro case, the vertex with the physical state is covariant under the group and is equivalent to the vertex introduced by Campagna et al. Using this equality, we can directly show that an amplitude for N external excited particles constructed by using the vertex is equal to the amplitude obtained from repeated factorization of tree dual graph. (auth)

18366 HIGH ENERGY PHYSICS INDEX. Volume 10, No. 26, 1972. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 64p.

18367 CRITERION FOR CLASSIFYING ELEMENTARY PARTICLES. Teleman, C.; Teleman, M. (Univ. of Bucharest). Compt. Rend., Ser. A; 275: No. 19, 943-944(6 Nov 1972). (In French).

A classification for elementary particles is proposed, using the Lie algebra canonical representation of the U(6) group in the ^{6}C tensor algebra. (France)

18368 PROPERTIES OF KAPUR–PEIERLS' EIGENSTATES AND EIGENVALUES. Lejeune, A.; Nagarajan, M. A. (Univ., Liege). Bull. Soc. Roy. Sci. Liege; 39: No. 5-6, 299-310(1970).

The Kapur–Peierls eigenstates and eigenvalues are numerically calculated for the case of a particle scattered by a square well potential. The energy dependence of the complex Kapur–Peierls eigenvalues is studied in the case of S- and P-wave scattering. The "resonance energy" is defined as the complex eigenvalue when its real part becomes equal to the incident projectile energy. It is noticed that there is no correlation between the exact poles of the S-matrix and the "resonance energies." It is noticed, however, that in the case of P-wave scattering, one of the resonance energies becomes approximately equal to the pole of the S-matrix, and that this pole describes a physical scattering resonance. The resonance energies are compared with the Wigner R-matrix eigenvalues and the corresponding widths. It is observed that the real part of the Kapur–Peierls energy agrees fairly well with the R-matrix eigenvalue, but the width predicted by Kapur–Peierls theory is about twice as large as that of the R-matrix theory. (auth)

18369 ENERGY–MOMENTUM SUM RULES AND INCLUSIVE REACTIONS. Ballestrero, A. (Univ., Turin); Predazzi, E. Nuovo Cim.; 13A: No. 2, 470-482(21 Jan 1973).

Some properties of inclusive reactions are studied, and the energy-momentum sum rules are rederived in a simpler and

more powerful way, both in the case of identical as well as of nonidentical particles. A universal asymptotic form for the inclusive cross sections which is suggested by the consideration of the sum rules is briefly discussed. (auth)

18370 HIGH ENERGY PHYSICS. Volume III. Burhop, E. H. S. (ed.). Pure and Applied Physics, a Series of Monographs and Textbooks, Volume 25. New York; Academic Press, Inc. (1969). 388p.

Three lectures are presented, which include K–N interactions, mesonic atoms, and weak interaction physics. A separate abstract is prepared for each lecture. (LBS)

For abstracts of individual lectures see: 18241, 18424, and 18485.

Electromagnetic

Refer also to abstract 18544.

18371 (CSIRO-Trans-11195) RADIATION OF FAST ELECTRONS IN A MAGNETIC FIELD IN THE PRESENCE OF A MEDIUM. Tsytevich, V. N. Translated by G. Losonci from Vestn. Mosk. Univ., Ser. Fiz.-Mat. Estest. Nauk; 6: No. 11, 27-36(1951). 9p. Dep. NTIS (U.S. Sales Only).

The Cherenkov "faster-than-light" electron effect and the radiating electron effect are examined in relation to certain radiation features of an electron in uniform circular motion within a dielectric medium. Electrodynamic fields of a charged particle in arbitrary motion within a dielectric medium, field of a charge in uniform circular motion, and an asymptotic approximation of the dependence of radiation intensity on the frequency are developed, and an analysis of the spectral intensity distribution and dispersion at frequencies significantly below natural is made. (MRM)

18372 (IFA-FT-96) NEW BOUNDS ON THE PION ELECTROMAGNETIC FORM FACTOR AND ITS DERIVATIVE. Ghika, Gr.; Visinescu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 12p. Dep. NTIS (U.S. Sales Only).

The aim of the paper is to study the pion electromagnetic form factor F(t) using the information that F(t) is bounded on the cut $4m_\pi^2 \leq t < \infty$ by a given function. One derives new bounds for the form factor assuming alternately that the derivative is F'(o) greater or smaller than a given number which permits the use of a stronger version of the Schwarz's lemma. One discusses the zeros of the form factor, its derivative and one obtains a new relation between the values of F(t) for real t in a given domain based on a theorem for the univalent functions. (auth)

18373 (IFA-FT-100) IMPROVED OPTIMAL BOUNDS USING THE WATSON THEOREM. Micu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 7p. Dep. NTIS (U. S. Sales Only).

A method is presented to find an optimal lower bound on the quadratic functional integrals which appear in the derivation of bounds on the hadronic contribution to the muon magnetic moment or on the K_{l3} form factors, when one knows that the function and its derivative take some definite values at the origin and that its phase is given on a part of the unitary cut. (auth)

18374 (JINR-P2-6839) ANALYTICITY PROPERTIES OF THE ELECTROMAGNETIC HADRON FORM FACTORS OFF-MASS-SHELL AND CONNECTION BETWEEN THE FORM FACTORS OF VARIOUS ELECTROMAGNETIC VERTICES. Bluvshtein, R. E.; Dubovik, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 68p. (In Russian). Dep. NTIS (U. S. Sales Only).

Consequence of the analyticity of the electromagnetic form factors in the invariant hadron masses and the unitarity condition has been investigated. The system of linear equations for the form factors $F_\pi(k^2)$, $F_{\omega(\rho)\pi\gamma}(k^2)$ and $F_{N^*_{1470}N\gamma}(k^2)$, allowing one to express them in terms of the nucleon form factors, was obtained by the sidewise dispersion relation in the elastic unitarity. The obtained meson form factors behave like k^{-2} for large k^2. The pion radius is equal to $r_\pi = r_N - 0.13f = 0.68f$. The magnetic moments of the transition $N^*_{1470} \to N\gamma$ are equal to $\mu^S_{N^*,N\gamma} = 0.95 \pm 0.061$, $\mu^S_{N^*,N\gamma} = -0.082 \pm 0.01$. The system of equations leads to the ratio $(1 + \mu^p)G_E^p(k^2)\,G_M^p(k^2)$ which deviates from the scaling in the region $k^2 \approx 4.2$ GeV^2, but no deviation appears at $k^2 = 0$ and $k^2 \gg 2$ GeV^2. In the framework of the Chew–Goldberger–Low–Nambu approach, a model of the electroproduction for the saturation of the sidewise dispersion relation has been chosen so that besides the Born terms there was taken into account the exchange of $\omega(\rho)$ mesons in the t-channel and the electric quadrupole $E^{3/2}_{1+}$ of the Δ_{33}-resonance in the μ-channel. (auth)

18375 (LNF-72/81) REGGEIZATION OF THE PHOTON IN QUANTUM ELECTRODYNAMICS. Pancheri-Srivastava, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.). 2 Oct 1972. 9p. Dep. NTIS (U. S. Sales Only).

Under certain assumptions it is shown that in massless QED the photon may reggeize. The technique involves a comparison of the infrared spectrum with that of the di-triple Regge expansion of inclusive processes. (auth)

18376 MAGNETIC POLES AND CHARGE QUANTIZATION. Efinger, H. J. (Univ. of Otago, Dunedin, New Zealand). pp 158-62 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

A simple model is presented which describes the interaction between electric and hypothetically assumed magnetic charges with the aim of deriving quantization rules for the two different kinds of charge. The interaction takes place in a uniform magnetic field; the motion of electrically charged particles is then subject to very simple quantization conditions. (JFP)

18377 COMPTON SCATTERING AND DEEP-INELASTIC ELECTROPRODUCTION. Kellett, B. H. (Univ. of Manchester, Eng.). Phys. Rev., D; 7: No. 1, 115-133(1 Jan 1973).

A Regge-pole model for inelastic electroproduction and Compton scattering is presented. The coupling of the virtual photon to hadrons is assumed to be mediated by the known vector mesons. An additional k^2 dependence is postulated such that each Regge pole scales. The electroproduction structure functions are then scale-invariant, and excellent fits to the photon total cross section, Compton scattering, and inelastic-electroproduction data are obtained. Vector-meson dominance of the electromagnetic current is formulated covariantly in terms of the invariant amplitudes, and a central assumption of the model is that the invariant and helicity amplitudes continue smoothly to the gauge-invariant limit as the photon mass goes to zero. The additional assumption of s-channel helicity conservation for Compton scattering leads to the prediction that the ratio of longitudinal to transverse virtual-photon cross sections is $-m^2k^2/\nu^2$. It is observed that if Regge poles dominate the electroproduction cross section for c.m. energies above 2 GeV, in the scaling limit nonleading trajectories become important for small values of ω. Such nonleading effects are shown to be important for the fit to the ratio of electroproduction off neutrons and protons. For larger values of ω, the model suggests that the cross section is predominantly diffractive, so that νW_2 has essentially reached its asymptotic value by $\omega \simeq 20$. The form of the scale-invariance breaking for small $|k^2|$ is correctly predicted, and it is found that the deviations from scale invariance are not necessarily characterized by a small mass. Some points relating to the interpretation of the results of the model are discussed. (auth)

18378 DIFFRACTIVE INTERACTIONS OF PHOTONS WITH HADRONS. Fuchs, N. H. (Purdue Univ., Lafayette, IN). Phys. Rev., D; 7: No. 1, 186-196(1 Jan 1973).

Diffractive interactions of photons with hadrons are described by a model based on (a) vector-meson dominance for vertex functions and (b) the f-coupled Pomeranchukon. Compton scattering, total photoabsorption, and vector-meson production on hydrogen as well as on complex nuclei are treated. The approach preserves the good results of the conventional vector-dominance model while accounting for its failures in a way that does no violence to the basic principles. Agreement with experiment is obtained for the process mentioned. The central point is that the Pomeranchukon coupling in Compton scattering is nonzero because of the existence of a fixed pole at J = 1, and that this pole has two distinct contributions to its residue. The contribution due to the third double-spectral function is naturally included in the usual vector-meson-dominance scheme; however, that due to the Born singularity is not included, so must be put in separately. (auth)

18379 SURFACE DOMINANCE IN DEEP-INELASTIC ELECTRON SCATTERING. Goldberg, H. (Northeastern Univ., Boston). Phys. Rev., D; 7: No. 1, 161-164(1 Jan 1973).

Let a finite part of the scaling curve $\nu W_2(\omega')$ at low ω' be locally dual to a set of resonances obeying mass formula $M_n^2 = a + m_n^2$. Then it is shown that a simple way of satisfying this condition within the context of several models is that the contributing resonance satisfy the condition $j \sim \sqrt{s}$. (auth)

18380 πN TOTAL CROSS SECTION, NEUTRINO REACTIONS, AND ELECTROPRODUCTION IN THE REGGE ASYMPTOTIC REGION. Langacker, P.; Suzuki, M. (Univ. of California, Berkeley). Phys. Rev., D; 7: No. 1, 273-275(1 Jan 1973).

It is shown from the Deser–Gilbert–Sudarshan representation

that the Pomeranchukon residue of the W_2 function for the axial-vector current is independent of Q^2. This justifies the relation $\sigma_{tot}^{\pi p}(\infty) = \frac{1}{2}\pi f_\pi^{-2} F_2^{(A)}(\infty)$ previously derived from generalized scaling. (auth)

18381 HOLE FRAGMENTATION IN DEEP-INELASTIC PROCESSES. Bjorken, J. D. (Stanford Univ., CA). Phys. Rev., D; 7: No. 1, 282-283(1 Jan 1973).

For deep-inelastic eN and νN processes it is argued that there are three fragmentation regions instead of two when ω is very large. (auth)

18382 RADIATIVE DECAYS OF $X^0(960)$ AND E(1420) MESONS. Nagorskaya, I. A. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 1, 3-10(1972). (In Russian).

The electromagnetic decays of $X^0(960)$ and E(1420) mesons were studied. The decays with the Dalitz pair production were analyzed in detail. The possibility of the determination of $X^0(960)$ and E(1420) spin-parity by their electromagnetic decays is stressed. (auth)

18383 NEW PHOTOPRODUCTION MODEL IN FIELD THEORY. II. Humpert, B. (Univ., Geneva). Nucl. Phys.; B52: No. 1, 173-188(1973).

An earlier study of a gauge-invariant field-theory model for pion photoproduction is continued. The complications due to photon and nucleon spin are considered. The infinity of higher-order graphs is summed to the form of a relativistic eikonal model for photoproduction and its static limit is determined. (auth)

18384 ELASTIC SCATTERING OF SLOW PARTICLES BY SOME LONG-RANGE POTENTIALS. Zhirnov, N. I.; Igropulo, V. S. (Moscow State Pedagogical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 73-79(1972). (In Russian).

The elastic s-scattering of slow particles by a number of model long-range potentials was investigated. The potentials were produced by joining together a Coulombic potential with a polarized potential of the form $-A \cdot (r + a)^{-4}$. (tr-auth)

18385 HARMONIC ANALYSIS OF THE DALITZ PLOT AND $\eta \rightarrow 3\pi$ DECAYS. Hicks, H. R. (Carnegie-Mellon Univ., Pittsburgh); Winternitz, P. Phys. Rev., D; 7: No. 1, 153-160(1 Jan 1973).

Three different types of two-variable expansions of three-body decay amplitudes and their square moduli are reviewed and compared—a recently suggested expansion based on the group O(4), the standard Dalitz–Fabri power series, and an SU(3) expansion suggested by B. W. Lee. Each of these expansions is then applied to analyze the recently obtained experimental Dalitz plot for the $\eta \rightarrow \pi^0\pi^+\pi^-$ decay. (auth)

18386 DUAL MODEL FOR THE DIFFRACTIVE PHOTOPRODUCTION OF ρ MESONS. Uretsky, J. L. (Argonne National Lab., IL). Phys. Rev., D; 7: No. 1, 140-146(1 Jan 1973).

Diffractive vector-meson photoproduction is studied in a dual model due to Neveu and Scherk that incorporates a gauge-invariant vector current. The structure of the amplitude turns out to be much more complicated than the vector dominance plus "Drell–Söding" structure often assumed for analyzing experimental data, although it is shown how even that structure involves some degree of "double counting." Experience with this model shows the need for a model with a realistic Pomeranchukon in order to understand experimental photoproduction data. (auth)

18387 GENERALIZATION OF THE BURNETT–KROLL SOFT-PHOTON THEOREM TO POLARIZED CROSS SECTIONS. Fearing, H. W. (Los Alamos Scientific Lab., NM). Phys. Rev., D; 7: No. 1, 243-247(1 Jan 1973).

Burnett and Kroll have shown from the Low soft-photon theorem that an unpolarized radiative cross section is given by an operator acting on the corresponding unpolarized nonradiative cross section. Tarasov has generalized this result to cases when all spins are not summed. His result is rederived here and is expressed in a substantially simpler and more useful way. Specifically it is shown that the cross section for a radiative process in which the particles involved have some particular polarization configuration is given through the first two orders in the photon momentum k by a simple operator acting on the cross section for the nonradiative process with arbitrary polarization. (auth)

18388 EXCLUSION PRINCIPLE FOR QUARKS AND THE RATIO $\nu W_2^{en}/\nu W_2^{ep}$. Niegawa, A. (Kyoto Univ.). Lett. Nuovo Cim.; 6: No. 2, 81-86(13 Jan 1973).

The resultant data for the e–d(hydrogen) structure function $\nu = (W^2 + q^2 - m^2)/2m$, where q and W are the momentum transfer of the electron and invariant mass of the final hadronic products, respectively, and m is the nucleon mass, are shown. These data are regarded as those of $R_{n/p}(\omega) = \nu W_2^{en}/\nu W_2^{ep}$, where ω is the usual scaling variable. Almost all phenomena but the tendency of $R_{n/p}$ can be explained by that quark-parton model based on the Gell–Mann–Zweig quark model in which the longitudinal-momentum distribution functions of quarks are independent of the kind of quarks. It is assumed that the exclusion principle acts between pairs of quarks. (JFP)

18389 SEPARATION OF VARIABLES IN A STATIONARY EQUATION OF SCHROEDINGER. Shapovalov, V. N.; Bagrov, V. G.; Meshkov, A. G. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 45-50(1972). (In Russian).

The problem of separating the variables in a stationary equation of Schroedinger was examined for a charge moving in an external magnetic field. The essential and sufficient conditions for separating variables in elliptical type of equations are discussed, to which there belongs Schroedinger's stationary equation. The application of the general theorem makes it possible to calculate all types of magnetic fields and coordinate systems in which variable separation in Schroedinger's stationary equation is possible. Systems of common differential equations are given which satisfy the wave function in the separated variables. (tr-auth)

18390 DEEP INELASTIC COMPTON SCATTERING IN THE SOFTENED-PARTON-FIELD MODEL. Kingsley, R. L. (Cambridge Univ., Eng.). Nucl. Phys.; B52: No. 1, 203-210(1973).

The connection between the process $\gamma + p \rightarrow \gamma +$ hadrons and deep inelastic electroproduction, which was suggested by Bjorken and Paschos, is derived in the softened-parton-field model of Landshoff, Polkinghorne and Short. Other contributions to the process that were suggested in perturbation-theory models are shown to be of lower order in the large energy variables. (auth)

18391 EFFECT OF A VACUUM MOMENT AND WAVE POLARIZATION ON THE RADIATION EMISSION OF AN ELECTRON. Korovina, L. I.; Klimenko, Yu. I.; Khudomyasov, A. I. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 140-142(1972). (In Russian).

The radiation emission of an electron is examined when moving in the field of a plane electromagnetic wave with an arbitrary polarization. The solution of a generalized Dirac equation is used in the description of the electron. An anomalous effect was observed for the influence of the magnetic moment on the polarization of a beam which corresponded to the emission from an electron in the field of a circularly polarized electromagnetic wave. (KSW)

18392 KINETIC EQUATION FOR CHARGED PARTICLES, ALLOWING FOR BREMSSTRAHLUNG. Gernet, G. E. (Leningrad Electrical Engineering Inst. of Communications). Dokl. Akad. Nauk SSSR; 204: No. 4, 812-13(1 Jun 1972). (In Russian).

The aggregate of charged particles under the influence of an electric and a magnetic field was considered under conditions of such low gas density that collisions between particles could be neglected. The effect of radiation loss by the charged particles was evaluated by means of an expression for the force of bremsstrahlung. (KSW)

18393 FIRST-ORDER NON-ABELIAN COMPTON EFFECT AND GENERALIZED CABIBBO–RADICATI THEOREM. Ragusa, S. (Instituto de Fisica e Quimica, Sao Carlos, Brazil). Phys. Rev., D; 7: No. 2, 563-565(15 Jan 1973).

It is shown that the first-order isospin-antisymmetric amplitude for the scattering of isovector photons on a spin $J \leq \frac{3}{2}$ target is determined by the isovector charge radius, magnetic moment, and quadrupole moment of the system. (auth)

18394 PHOTON–VECTOR-MESON COUPLING IN A TENSOR DESCRIPTION OF VECTOR MESONS. Kyriakopoulos, E. (Democritus Nuclear Research Centre, Athens). Phys. Rev., D; 7: No. 2, 569-571(15 Jan 1973).

The photon–vector-meson coupling is discussed in a model in which the vector mesons are described by means of an antisymmetric second-rank tensor field. In this description gauge invariance allows the presence of a direct photon–vector-meson coupling, by itself, in the Lagrangian. (auth)

18395 PROTON–NEUTRON MASS DIFFERENCE IN A UNIFIED GAUGE MODEL OF LEPTONS AND HADRONS. Hagiwara, T.; Lee, B. W. (State Univ. of New York, Stony Brook). Phys. Rev., D; 7: No. 2, 459-465(15 Jan 1973).

Some problems associated with the physical interpretation and the renormalization of the model devised by Weinberg which combines the SU(2) × U(1) gauge theory of leptons and the σ model are discussed. Some of the problems discussed are: (1) renormalization counterterms of this model, (2) complications due to the existence of two scalar multiplets which develop vacuum expectation values, (3) the proton-neutron mass difference in this model.

It is pointed out that in this model there is a "zeroth-order" relation connecting the proton-neutron mass difference and certain coupling constants. Departure from this relation in higher orders is computable and the one-loop correction to this relation is discussed. (auth)

18396 MASS DIFFERENCES IN A UNIFIED THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Dicus, D. A.; Mathur, V. S. (Univ. of Rochester, NY). Phys. Rev., D; 7: No. 2, 525-531(15 Jan 1973).

The soft-pion and soft-kaon mass differences are calculated in the Weinberg model of weak and electromagnetic interactions. Both are found to be finite without using the second spectral-function sum rule. In addition several comments are made about mass differences of massive hadrons. (auth)

18397 PAIR PRODUCTION BY PHOTONS. 1. EXACT CALCULATION FOR UNSCREENED ATOMIC FIELD. Oeverboe, I.; Mork, K. J.; Olsen, H. A. Ark. Fys. Seminar Trondheim; No. 11, 1-62(1972).

Exact relativistic Coulomb wave functions, in the form of partial wave expansions, are used to obtain analytic formulas for the differential cross sections and energy spectrum for electron-positron pair production by photons. Radiative corrections believed to be of the order to 1% are neglected. Errors introduced by the finite nuclear size and recoil effects are negligible for the energy region considered. Apart from these approximations the formulas give the exact cross sections for the unscreened atomic field. Numerical results are given for positron energy spectra for a large number of photon energies and atomic numbers in the ranges $2m_ec^2 < k \leq 10m_ec^2$ and $1 \leq Z \leq 100$. Total cross sections are obtained by numerical integration of the spectra. A representative choice of spectra is given. The around five hundred total cross sections calculated are given in tables and diagrams. By interpolation in these data the total cross section for any photon energy and nuclear charge within the given limits may be obtained with an accuracy of one percent or better. For heavy elements large Coulomb corrections to the Bethe–Heitler Born approximation results are found. The positron energy spectra obtained are asymmetric, favoring positrons of high energy. The total cross section σ is smaller than the Bethe–Heitler total cross section σ_B for photon energies very close to the threshold (due to the repulsion of the positron), while σ is generally larger than σ_B in the energy region $2.2m_ec^2 \lesssim k \lesssim 10m_ec^2$. (auth)

18398 PHENOMENOLOGICAL COMPARISON OF EP AND PP INELASTIC SCATTERING. Kuroda, M. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1918-1922(Dec 1972).

Comparison between ep and pp inelastic scattering is performed phenomenologically. It is found that in fairly large t region, the t dependence shows the similar behavior for ep and pp inelastic scattering. (auth)

18399 PHOTON REST MASS. Strnad, J. Obz. Mat. Fiz.; 19: No. 4, 169-178(Oct 1972). (In Slovene).

The accuracy with which experimental data confirm the equations of Maxwell's electrodynamics with a zero photon rest mass is considered. Phenomena that would be encountered if the photon should have a non-zero rest mass are reviewed. Some experiments are discussed briefly and upper limits for the photon rest mass that can be deduced from experimental data are estimated. (auth)

18400 APPLICATION OF FRITZSCH—GELL-MANN ALGEBRA TO THE DEEP INELASTIC PROCESSES $e + N \rightarrow e + \gamma$ + ANYTHING AND $\nu + N \rightarrow l + \gamma$ + ANYTHING. Murtaza, G.; Razmi, M. S. K. (Univ. of Islamabad, Pakistan). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1960-1976(Dec 1972).

The processes $e + N \rightarrow e + \gamma$ + anything and $\nu + N \rightarrow l + \gamma$ + anything, where l is a charged lepton, are studied in generalized Bjorken limits of two types. In the kinematical regions considered, the light cone algebra of vector and axial-vector currents suggested by Fritzsch and Gell-Mann is applied. This leads to relations between the nonbremsstrahlung part of each process above and the corresponding process without the detection of the final state photon. These relations may be regarded as Ward identities for a hard photon. Finally, structure functions of the nonbremsstrahlung parts are found to scale. (auth)

18401 ELECTROMAGNETIC MESON DECAYS AS A TEST OF A RELATIVISTIC-CONSTITUENT QUARK MODEL. Flamm, D.; Sanchez, J. Lett. Nuovo Cim.; 6: No. 4, 129-132(27 Jan 1973).

The results of the static quark model for $V \rightarrow p + \gamma$ and $P \rightarrow V + \gamma$ decays (V = vector meson, P = pseudoscalar meson) are derived by the use of a relativistic invariant constituent Fermi-quark model based on the Bethe-Salpeter equation and the effective current operator. The correct $\pi^0 \rightarrow 2\gamma$ rate is also obtained without introducing three triplets of quarks. (auth)

18402 ELECTRON-BREMSSTRAHLUNG INTERACTIONS. Aiginer, H.; Unfried, E. (Oesterreichische Hochschule, Vienna). Acta Phys. Austr.; 35: No. 4, 331-348(1972). (In German).

The experimental work devoted to electron-bremsstrahlung interactions of 180 to 2000 keV electrons at the Accelerator Department of the Atominstitut der Osterreichischen Hochschulen is reviewed in the sight of recent theoretical publications dealing with this topic. The electron-bremsstrahlung cross sections $d^2\sigma/dkd\Omega_k$ and $d\sigma/dk$ are compared with the theoretical results of Brysk, Zerby, and Penny and Tseng and Pratt as well as with the results of earlier theoretical publications. In contradiction to Resters work no indication of electron-electron bremsstrahlung was found using 2 MeV electrons and Li (Z = 3) targets. The linear polarization of the 2 MeV bremsstrahlung spectra and the high energy limit for 1.84 MeV bremsstrahlung spectra have been studied carefully. Measurement of the high energy limit cross sections $d^2\sigma/dkd\Omega_k$ for Li, Al, Cu, Ag, and Au show that the theoretical results of Elwert–Haug, Scherzer and Sauter–Fano do not agree with the experiment. (tr-auth)

18403 INELASTIC EFFECTS IN MULTIPION PRODUCTION IN ELECTRON–POSITRON ANNIHILATION AT LOW ENERGY. Bonneau, G.; Martin, G. (Laboratoire de Physique Theorique et Hautes Energies, Paris). Nuovo Cim.; 13A: No. 2, 413-426 (21 Jan 1973).

The influence of inelastic unitarity on vector-meson dominance predictions is considered. It is shown that, taking $\pi\pi$ and $\pi\omega$ channels into account, predictions on ω decays can be changed considerably and can be reconciled with experimental results. For ρ decay: the corrections on the relation $f_{\rho\pi\pi}/f_\rho = 1$ are small, the influence on the decays $\rho \rightarrow \pi^+\pi^-$ and $\rho \rightarrow \pi^+\pi^-\pi^0\pi^0$ above 1 GeV is important. (auth)

18404 NEW BOUNDS ON THE PION ELECTROMAGNETIC FORM FACTOR AND ITS DERIVATIVE. Ghika, G.; Visinescu, M. (Inst. for Atomic Physics, Bucharest). Nuovo Cim.; 13A: No. 2, 385-396(21 Jan 1973).

The aim of this paper is to study the pion electromagnetic form factor F(t) with the aid of the information that F(t) is bounded on the cut $4m_\pi^2 \leq t < \infty$ by a given function. One derives new bounds for the form factor assuming alternately that the derivative F'(0) is greater or smaller than a given number; this permits the use of a stronger version of Schwarz's lemma. One discusses the zeros of the form factor and its derivative, and obtains a new relation between the values of F(t) for real t in a given domain based on a theorem for univalent functions. (auth)

Weak

Refer also to abstracts 18336, 18793, and 18841.

18405 (JINR-P2-6739) REPRESENTATION (1.8) + (8.1) IN STRONG INTERACTION HAMILTONIAN. Khelashvili, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

Taking into account the representation (1.8) ⊕ (8.1) in the hadron Hamiltonian the sum rule is obtained for the form factor of Kl_3-decay, which is of the same form as taken without account of this representation. It is shown that disagreement existing in the GMORGW model between the meson mass spectrum and the behavior of Kl_3-decay form factors can be eliminated. It is also proved that inclusion of a new representation gives possibility of describing the 6-terms in meson–baryon scattering. (auth)

18406 TESTS FOR NEUTRAL CURRENTS IN NEUTRINO REACTIONS. Paschos, E. A. (National Accelerator Lab., Batavia, IL); Wolfenstein, L. Phys. Rev., D; 7: No. 1, 91-95(1 Jan 1973).

Neutral currents predicted by weak-interaction models of the type discussed by Weinberg may be detected in neutrino reactions. Limits on the ratio R of $\sigma(\nu + N \rightarrow \nu + X)$ to $\sigma(\nu + N \rightarrow \mu^- + X)$ are obtained independent of any dynamical assumption. For the total cross section for high-energy neutrinos, $R \geq 0.18$, provided the Weinberg mixing angle satisfies $\sin^2\theta_W \leq 0.33$. For the production of a single π^0 $R' \geq 0.50$ contrasted with the experimental result $R' \leq 0.14$ using only the assumption of (3,3)-resonance dominance. Applications are also given to antineutrino reactions. (auth)

18407 HEAVY-LEPTON PRODUCTION IN INCLUSIVE NEUTRINO REACTIONS. Albright, C. H. (Northern Illinois Univ., DeKalb). Phys. Rev., D; 7: No. 1, 63-74(1 Jan 1973).

Production of heavy μ-type leptons in inclusive neutrino reactions is studied phenomenologically by means of a Monte Carlo calculation. The single-particle inclusive spectrum is found to be distorted in a characteristic fashion when lepton locality is violated by the production of a heavy (excited) lepton. Various tests

are presented which are sensitive to heavy leptons with masses up to 3 GeV. (auth)

18408 PION MECHANISM FOR THE PROCESS $\gamma + \gamma \rightarrow \nu + \bar{\nu}$. Schreiber, W. (Staten Island Community Coll., NY). Phys. Rev., D; 7: No. 1, 201-206(1 Jan 1973).

A mechanism involving pions in the intermediate state is considered for the process $\gamma + \gamma \rightarrow \nu + \bar{\nu}$. Fixed-momentum dispersion relation methods are employed to evaluate the cross sections and luminosities for both electron-type and muon-type neutrinos. Comparison is made between this mechanism and previous results involving intermediate bosons. (auth)

18409 $SU(6)_W$ MODEL OF $\Delta S = 0$ AND $\Delta S = 1$ NONLEPTONIC PARITY-VIOLATING WEAK INTERACTIONS. McKellar, B. H. J.; Pick, P. (Univ. of Sydney). Phys. Rev., D; 7: No. 1, 260-266 (1 Jan 1973).

A model of parity-violating nonleptonic baryon decays is constructed in which the effective Hamiltonian has the $SU(6)_W$ transformation properties of the Cabibbo Hamiltonian. This model reproduces the well-known current-algebra results for the S-wave hyperon decays and the parity-violating $NN\pi$ and $N^*N\pi$ couplings. With the further assumption of octet dominance in the parity-violating NNV amplitudes can be obtained, where V is a vector meson. The important result that the parity-violating $NN\rho^0$ and $NN\omega$ amplitudes cannot both vanish in the Cabbibo theory is found, as has heretofore been assumed. The NNV amplitudes cannot be obtained without additional assumptions. Various assumptions lead to coupling constants which may vary in sign and in magnitude by a factor of 8, but are of the order of magnitude of those obtained by the factorization hypothesis. (auth)

18410 EFFECTS OF A NEUTRAL INTERMEDIATE BOSON ON LEPTONIC ATOMS. Repko, W. W. (Michigan State Univ., East Lansing). Phys. Rev., D; 7: No. 1, 279-281 (1 Jan 1973).

The effect of a neutral vector boson on the hyperfine interval of the $\mu^+ - e^-$ bound system is calculated using Weinberg's $SU(2) \times U(1)$ lepton model. A lower limit on the mixing parameter θ is obtained, and some consequences of the additional neutral bosons predicted by the $SU(3) \times SU(3)$ version of the model are examined. (auth)

18411 ELECTROMAGNETIC CORRECTIONS FOR LEPTON DECAY OF NEUTRAL VECTOR MESONS. Kerimov, B. K.; Tsvetkov, V. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 367-369(1972). (In Russian).

In the interpretation of experimental data on the lepton mode of decays of vector mesons ($V = \rho^0, \omega, \varphi \rightarrow e^+e^-; \mu^+\mu^-$), an important role is played by the radiative corrections to the partial width for ρ^0, ω, φ-meson decays into an electron-positron (or muon) pair. Expressions are presented for this type of correction and for partial decay widths (e.g., $V \rightarrow l^+l^-$). (KSW)

18412 EXOTIC HADRON WEAK CURRENTS. Oakes, R. J. (Northwestern Univ., Evanston, IL); Primakoff, H. Phys. Rev., D; 7: No. 1, 275-277(1 Jan 1973).

The possibility that the hadron weak current contains an "exotic" strangeness-conserving isotensor component and/or an "exotic" strangeness-changing isospin-$\frac{3}{2}$ component is considered. Several neutrino experiments which can provide tests for the presence of such components are briefly described. (auth)

18413 SPIN-0 PHENOMENOLOGY OF K_{l3} DECAYS IN THE K*-POLE MODEL. Fischbach, E. (Purdue Univ., Lafayette, IN); Nieto, M. M.; Scott, C. K. Phys. Rev., D; 7: No. 1, 207-214 (1 Jan 1973).

Both the Duffin-Kemmer-Petiau (DKP) and Klein-Gordon (KG) K*-pole model descriptions of K_{l3} decays are discussed in detail and are compared to experiment. Significant differences are found between the two models, with the experimental data tending to favor the DKP version. In three Appendixes important aspects of using the DKP formulation to describe K_{l3} decays are explained in detail. (auth)

18414 SOME NEUTRINO-LEPTON PROCESSES ASSUMING THE EXISTENCE OF A NEUTRINO-PHOTON INTERACTION. Romanov, Yu. I.; Gnedov, Yu. A. (Sterlitamak State Univ., USSR). Isv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 35-38(1972). (In Russian).

The energy distribution of final electrons during νe- and $\tilde{\nu}e$-scattering was obtained, making allowance for the polarization of the initial electron in the supposition that these processes occur because of a current-current (V-A)- interaction and a hypothetical weak photon-neutrino interaction. (KSW)

18415 MUON DECAY AND EQUIVALENCE PRINCIPLE. Smorodinskii, Ya. JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 356-357(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 499-501(20 Oct 1972).

The calculation of the proper time for a muon in a magnetic field is discussed. It is pointed out that the decay of a meson moving on a circular orbit in cyclotron should be calculated by means of a formula similar to that for the proper time measured with a clock on an earth satellite. It is noted that by virtue of the equivalence principle it seems impossible to distinguish between a potential in a gravitational and an electromagnetic field. A formula is found which can be regarded as that for the lifetime corrected for the external field. (JFP)

18416 MECHANISM FOR OCTET ENHANCEMENT IN S-WAVE NONLEPTONIC DECAYS. Katz, J.; Tatur, S. (Freie Univ., Berlin). Phys. Rev., D; 7: No. 2, 531-534(15 Jan 1973).

The mechanism of Li and Pagels is used to discuss the S-wave nonleptonic decays of mesons and baryons. It implies that the decays $\Sigma^+ \rightarrow n\pi^+$ and $K^+ \rightarrow \pi^+\pi^0$ do not occur and thus the $\Delta I = \frac{1}{2}$ rule and the Lee-Sugawara relation hold. Moreover, it also yields a relation between the F/D ratio for nonleptonic hyperon decays and the F/D ratio for the semileptonic decays. (auth)

18417 GAUGE THEORY OF WEAK AND ELECTROMAGNETIC INTERACTIONS WITH HAN-NAMBU QUARKS. Georgi, H.; Glashow, S. L. (Harvard Univ., Cambridge, MA). Phys. Rev., D; 7: No. 2, 561-563(15 Jan 1973).

Han-Nambu quarks are used to construct an SO(3) gauge theory of weak and electromagnetic interactions which is compatible with the naive quark model. The model is constrained by the requirements that $K_L \rightarrow \mu\bar{\mu}$ is suppressed and the K_L-K_S mass splitting is small. This leads to a relation between the W mass and the Cabibbo angle, which determines the W mass to be near 35 GeV. (auth)

18418 SOME PHYSICAL CONSTRAINTS ON GAUGE MODELS OF WEAK INTERACTIONS. Lee, B. W.; Primack, J. R.; Treiman, S. B. (National Accelerator Lab., Batavia, IL). Phys. Rev., D; 7: No. 2, 510-516(15 Jan 1973).

Recently proposed models of weak interactions based on spontaneously broken gauge symmetry contain additional interactions arising from exchange of the scalar Higgs particles and/or neutral vector bosons. Further, higher-order corrections are finite, and therefore should be taken seriously. The constraints on parameters of models that are imposed by consideration of Higgs-particle exchange and of higher-order effects in K decays are investigated. To bring out the main points attention is focused mainly on the SO(3) models of Georgi and Glashow. In the 5-quark version of the Georgi-Glashow model, the Higgs scalar couples strongly to $(\bar{\lambda}N)$, and to $(\bar{e}e)$, so that processes such as $K^+ \rightarrow \pi^+ + e + \bar{e}$ decay can occur already in lowest order. Thus a stringent lower bound ($m_\phi \geq 10$ GeV) is imposed on the mass of the scalar particle. For the process $K_L \rightarrow \mu + \bar{\mu}$, which occurs in second order, the amplitude is found to be of order $G_F\alpha \sin\theta_C$ and independent of the value of M_W. This is clearly in contradiction with experiment and rules out the 5-quark version. Also an 8-quark version of the model is analyzed, in which extra quarks are used to suppress the amplitudes for $K_L \rightarrow \mu + \bar{\mu}$ and $K^0 \rightarrow \bar{K}^0$: The amplitudes are of order $G_F\alpha(\Delta m^2/M_W^2)$, where Δm^2 is the difference between the squared masses of "charmed" and "uncharmed" quarks. It is also shown that in this version single-scalar-particle exchange is altogether forbidden and the constraint on m_ϕ is accordingly eliminated. Constraints similar to those found for the Georgi-Glashow models also apply to other spontaneously broken gauge models of weak interactions. (auth)

18419 SOFT-PION LIMIT AND $K_{2\pi}$ DECAYS. Kikugawa, H. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1977-1985(Dec 1972).

The current algebra with the usual soft-pion limit has some problems in the calculation of hadronic decays: (i) the $K_{2\pi}$-decay amplitudes critically depend on which pion is assumed to be soft, (ii) the only intermediate states which can contribute to the pole terms must have the same masses as those of the initial and final particles. As a result the resonances do not give any contributions, (iii) the initial and final particles must have the same masses, i.e., $m_\Lambda = m_n$, $m_K = m_\pi$, etc. We will show that these problems can be avoided if one takes the soft-pion limit in the rest frame of the pion. (auth)

18420 WEAK AND ELECTROMAGNETIC FORCES AS A CONSEQUENCE OF THE SELF-INTERACTION OF THE γ-FIELDS. Novello, M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 18: No. 25, 351-358(1972).

A model is proposed with geometrized electromagnetic and weak forces. The absence of electromagnetic properties of the neutrino is understood in terms of a symmetry principle. (auth)

18421 MUON INELASTICITY IN HIGH-ENERGY NEUTRINO INTERACTION. Okumura, Y. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2106-2107(Dec 1972).

The inelasticity of the muon in the scale region of the $\nu + p$ interaction is calculated. The counting picture which is the universal connected F-type coupling of the vector trajectory to any external hadron in the forward direction, the requirement of super exchange degeneracy, and Pomeranchuk dominance are assumed. (JFP)

18422 SU_3 BREAKING AND WEAK CHARGES. Buccella, F. (Univ., Rome); Nicolo, F.; Savoy, C. A. Lett. Nuovo Cim.; 6: No. 5, 173-176(3 Feb 1973).

A connection between the SU(3) × SU(3) chiral algebra of the electromagnetic and weak charges and the classification group SU(6) × O(3) was previously proposed, under the assumption of exact SU(3) symmetry. The assumption of exact SU(3) symmetry is released, and it is proposed that the axial charges and the corresponding generators of SU(6) should be connected by a unitary transformation. Matrix elements of the vector and axial charges appearing in the leptonic decays of the baryon octet are predicted. The matrix elements between the states of the baryon octet are also predicted. (LBS)

18423 WEINBERG'S MODEL OF WEAK INTERACTIONS AND STRUCTURES OF HADRONS AND LEPTONS. Prokhorov, L. V. (Leningrad State Univ.). JETP Lett. (USSR) (Engl. Transl.); 16: No. 10, 397-398(20 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 10, 561-563.

It is pointed out that the inclusion of hadrons in Weinberg's model of weak and electromagnetic interactions leads to definite consequences concerning the structures of hadrons and leptons. (LBS)

18424 WEAK INTERACTION PHYSICS. Rubbia, C. (CERN, Geneva). pp 283-350 of High Energy Physics. Vol. III. Burhop, E. H. S. (ed.). New York; Academic Press, Inc. (1969).

The lecture on weak interaction physics deals with leptonic interactions, semileptonic interactions, and symmetry rules in weak decays. (LBS)

Strong (General)

Refer also to abstracts 18237 and 18345.

18425 (HU-TFT-72-21) INCLUSIVE MASS DEPENDENCE OF THE MOMENTUM TRANSFER DISTRIBUTIONS IN THE DUAL RESONANCE MODEL. Vallinkoski, M. K.; Raitio, R. O. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Sep 1972. 16p.

The diagrams contributing in the single Regge limit ($s \to \infty$, momentum transfer and missing mass fixed and small) in inclusive reactions were calculated using the discontinuity of the dual six-point function. The mass dependence of the momentum transfer distributions was numerically investigated in the low missing mass region. (auth)

18426 NATURE OF THE NUCLEAR BOND AND HADRON STRUCTURE. Barut, A. O. (Univ. of Colorado, Boulder). pp 22-80 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The review of the nuclear bond and hadron structure covers nuclear forces and analogy with the chemical bond, nucleon structure and nuclear forces, and magnetic charges and proton structure. (JFP)

18427 DUALITY AND SINGLE-PARTICLE INCLUSIVE SPECTRA INVOLVING BARYONS. Frampton, P. H. (Univ., Bielefeld, Ger.). Lett. Nuovo Cim.; 6: No. 2, 58-62(13 Jan 1973).

The quark diagrams were included for single-particle inclusive spectra such that the topology peculiar to baryons is recognized, but with a minimal modification to the nonexotic meson case by using certain rules. The results are that the number of components for single-particle spectra is increased from seven to ten and that the cross terms between different quark topologies within a given component give rise to significant additional nonscaling contributions. Inclusive single-hadron spectra in various strong interactions are considered. (JFP)

18428 DYNAMICAL MODEL FOR AN INELASTIC RESONANCE. Coulter, P. W. (Univ. of Alabama, University). Phys. Rev., D; 7: No. 1, 96-101(1 Jan 1973).

A dynamical model of a resonance interfering with an inelastic background is presented. The scattering amplitude is written as a resonant term plus a unitary background. The width of the resonance is found to be a function of the background scattering amplitude. The case of two resonances interfering with each other and with an inelastic background is also studied. Implications of the model with regard to determining masses and widths of resonances and coupling constants in unitary symmetry schemes are discussed. (auth)

18429 DUALITY AND DIFFRACTION DISSOCIATION. Einhorn, M. B. (Univ. of California, Berkeley); Green, M. B.; Virasoro, M. A. Phys. Rev., D; 7: No. 1, 102-108(1 Jan 1973).

Diffraction dissociation is discussed in the context of a dual model. It is shown how direct-channel resonances in the Pomeranchukon-particle amplitude build the Pomeranchukon in the crossed channel. A result of the enforcement of the Harari–Freund conjecture for particle-particle amplitudes is that the Pomeranchukon–Pomeranchukon–Reggeon coupling is small. The model is tested phenomenologically by the analysis of $\pi^- p \to \pi^- p(\pi^+\pi^-)$ of Lipes, Robertson, and Zweig and by baryon missing-mass data at various energies. It is also tested phenomenologically by the behavior of missing-mass diffraction production peaks, which are predicted to level off or dip near the forward direction as a consequence of the vanishing of the triple-Pomeranchukon coupling. (auth)

18430 TRANSVERSE-MOMENTUM DISTRIBUTIONS IN HIGH-ENERGY COLLISIONS. Saunders, L. M.; Soper, D. E. (Princeton Univ., NJ). Phys. Rev., D; 7: No. 1, 133-139(1 Jan 1973).

The distribution in transverse momentum of particles produced in very high-energy hadronic collisions is studied using a general class of Gaussian models. The models are exactly soluble and readily compared with experiment, given the lowest moments of single-particle and two-particle distributions. Perhaps most important, they provide a simple framework for prototypes of specific dynamical schemes, such as multiperipheral or statistical models in which the general trends and signatures of these schemes are readily apparent. (auth)

18431 INCLUSIVE PRODUCTION OF VECTOR MESONS IN THE DUAL-RESONANCE MODEL. Kang, K.; Shen, P. (Brown Univ., Providence). Phys. Rev., D; 7: No. 1, 164-171 (1 Jan 1973).

The vector-meson inclusive distribution is considered by making use of the eight-point dual amplitude for which two of the external lines are regarded as the decay products of a single vector meson. It is found that the vector-meson vertex is factorizable both in the fragmentation and central regions only for large values of $\kappa = p_1^2 + m^2$. Nonfactorizability for low values of κ is due to the correlations between the beam-target system and the decay products. Explicit and yet simple expressions for the vertex function as well as the vector-meson production cross section are given to the leading order in κ for the triple-Regge and pionization limits. They show that the vector-meson decays, in either of the kinematic regions, along the preferred beam direction with a $\cos^2\beta$ dependence, in the rest frame of the vector meson, provided that the intercept of the leading vacuum trajectory takes the value unity. Furthermore, it is found that in the central region the states with helicity ±1 contribute dominantly to the decay correlations, while in the triple-Regge region the state with helicity zero is favored. (auth)

18432 FAILURE OF A SELF-CONSISTENT DIFFRACTIVE MULTIPERIPHERAL MODEL IN THE STRONG-ORDERING LIMIT. Jones, S. T. (Univ. of Alabama, University). Phys. Rev., D; 7: No. 1, 197-201(1 Jan 1973).

A multiperipheral model incorporating both ordinary Regge and Pomeranchuk exchange is considered. The Pomeranchukon is limited to a single exchange, and the calculation assumes strong ordering of final particles. It is found that both trajectories can be treated in a self-consistent manner, but that the predictions of the model disagree strongly with experiment when the bootstrap condition is satisfied. (auth)

18433 COULOMB–NUCLEAR INTERFERENCE. Franco, V. (Brooklyn Coll., NY). Phys. Rev., D; 7: No. 1, 215-217(1 Jan 1973).

The phase difference between strong and electromagnetic contributions to the scattering amplitude is derived from diffraction theory. The results are consistent with relativistic calculations. Bethe's phase is shown also to be consistent with relativistic calculations. New expressions for the amplitude are obtained to all orders in $Z_1 Z_2 e^2/\hbar v$ for the point-charge and extended-charge cases. Cross sections calculated from the original expression and from the point-charge solution are compared with those of the extended-charge solution. (auth)

18434 CHARGE CORRELATIONS IN HIGH-ENERGY MULTIPLICITY PROCESSES. Rotelli, P. (International Atomic Energy Agency, Trieste, Italy). Phys. Rev., D; 7: No. 1, 230-233(1 Jan 1973).

It is suggested that a fruitful way of analyzing high-energy multiparticle processes is to search for charge correlations. Certain models predict characteristic patterns independent of detailed dynamical considerations. (auth)

18435 INCLUSIVE PHOTON DISTRIBUTIONS: CONTRIBUTIONS FROM π^0's AND BREMSSTRAHLUNG. Cahn, R. N. (Univ. of California, Berkeley). Phys. Rev., D; 7: No. 1, 247-259(1 Jan 1973).

Photons produced in high-energy hadronic collisions come primarily from π^0 decays. If the π^0 inclusive cross section exhibits Feynman scaling, then so does the derived photon spectrum. The scaled photon-spectrum behavior in the central region (x = 0) is examined in detail. The bremsstrahlung contribution can be estimated for not too energetic photons, and provides a means for measuring the mean charged multiplicity at very high energies. (auth)

18436 CLOSED-LOOP CORRECTIONS TO THE $SU_3 \times SU_3$ σ MODEL: ONE- AND TWO-POINT FUNCTIONS. Chan, L. H.; Haymaker, R. W. (Louisiana State Univ., Baton Rouge). Phys. Rev., D; 7: No. 2, 402-415(15 Jan 1973).

The calculation of one-loop corrections to the one- and two-point functions in the renormalizable SU_3 σ model with a symmetry-breaking term $L_{SB} = \epsilon_0\sigma_0 + \epsilon_8\sigma_8$ is presented. Renormalization was made at the masses of π, K, η, η', σ, and f_π. The second-order corrections are found to be small compared to tree-approximation values. The measure of octet breaking, $b = \langle\sigma_8\rangle/\sqrt{2}\langle\sigma_0\rangle$, changes less than 5%. The value of $a = \epsilon_8/\sqrt{2}\epsilon_0$ is insignificantly changed. The scalar-meson masses are shifted by less than 10%, with the exception of the σ'. The widths are large, with the exception of the π_N. Corrections to f_K/f_π, the wave-function renormalization constants, mixing angles, and the renormalized π and K propagators at $q^2 = 0$ are calculated. (auth)

18437 RENORMALIZATION OF THE $SU_3 \times SU_3$ σ MODEL. Chan, L. H.; Haymaker, R. W. (Louisiana State Univ., Baton Rouge). Phys. Rev., D; 7: No. 2, 415-423(15 Jan 1973).

The renormalization procedure for the SU_3 σ model was carried out through second order in the presence of symmetry-breaking terms. It is shown explicitly that no new divergent counterterms are needed other than those required in the symmetric theory. The theory can be completely determined in terms of known masses and the decay constant f_π. (auth)

18438 ACTION-AT-A-DISTANCE THEORIES AND DUAL MODELS. Ramond, P. (Yale Univ., New Haven). Phys. Rev., D; 7: No. 2, 449-458(15 Jan 1973).

The most general classical formulation of Poincaré-invariant action-at-a-distance theories is written and their classical applications are reviewed. Their bootstrap like properties are stressed. In particular, an attempt is made to view dual amplitudes in terms of the radiation reaction of "dual atoms." (auth)

18439 EFFECTS OF STRONGLY ABSORPTIVE INTERACTIONS. Koch, Justus Hildebrand. Amherst, Mass.; Univ. of Massachusetts (1972). 92p. University Microfilms Order No. 72-22,032.

Thesis.

Recently the technique of optical potentials was applied to the decaying eigenstates of exotic atoms. When Krell used this approach to interpret the x-ray spectrum of K-mesic atoms, the predicted eigenvalues showed an oscillatory dependence on the well parameters. Motivated by these intriguing effects we study the properties of absorptive systems using a highly simplified model for the exotic atom. We find that in the presence of strong absorption the spectrum of such a system consists of two distinct sets of eigenstates. In addition to the familiar "outer" eigenstates, which barely penetrate into the absorptive region, there is a class of "inner" states. These new eigenstates are essentially confined to the absorptive region. We show how nonlinearities, analogous to the ones observed by Krell, arise from the weak coupling between inner and outer states. To further generalize our observations, we describe an analogous situation by a simple coupled channels model. Again we obtain a similar behavior of the eigenvalues, confirming thus that the inner states and the associated phenomena are physically meaningful and model-independent. Finally we turn to a realistic description of the K-mesic atom. We are able to fit the presently available data for shifts and linewidths of K-mesic atoms with one common set of potential parameters. Earlier first-order calculations are compared to the exact solutions we obtain with these fitted parameters. For one case we trace down an inner state and show how nonlinear effects arise as it crosses an outer state. The enormous width of the inner state makes observations of direct transitions unlikely. We therefore discuss other ways to confirm the existence of inner states in exotic atoms experimentally. (Diss. Abstr. Int., B)

18440 QUARK MODEL. Bialas, A. (Jagellonian Univ., Krakow); Zalewski, K. Zesz. Nauk. Univ. Jagiellon., No. 231, Pr. Fiz.; No. 8, 11-29(1970).

Review lectures are given on the application of the quark model to two-body strong interactions in which two ingoing particles go over into two outgoing particles which need not be stable. The wave functions of particles in terms of quarks, small- and large-angle scattering, backward scattering, form factors, symmetry without symmetry, and detailed results of the quark model for cross section relations and resonance spin–density matrix relations are treated. (JFP)

18441 NOTES ON SOME APPLICATIONS OF MORAVCSIK'S PARTIAL WAVE ANALYSES. Yamaguchi, Y. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1755(Nov 1972).

Moravcsik has proposed a method for phase-shift analysis of high-energy hadron–hadron scattering in which a large number of partial waves participate. He has suggested use of two smooth functions f(l) and g(l) to be fitted to the S-matrix elements. Three comments are made on this analysis. For some hadron–hadron scattering it would be sensible to use two different pairs of functions, for even and odd l. It is expected that OPE contributions would dominate in the scattering amplitude for large l. For elastic nucleon–nucleon scattering f(l) and g(l) should be the same order of magnitude; on the other hand, OPE cannot contribute to elastic $\pi-\pi$ or $\pi-N$ scattering but does to inelastic collisions; hence, f(l) should approach zero much faster than g(l). Moravcsik's analysis may be applied conveniently to the phase-shift analysis of high-energy heavy ion–nucleus scattering (of the type: two-body → two-body), provided that the Coulomb (+centrifugal barrier) phases are suitably taken into account. (RWR)

18442 HIGH-ENERGY APPROXIMATION AND A GENERALIZED HUYGENS' PRINCIPLE. Sitenko, A. G.; Peresypkin, V. V. (Inst. for Theoretical Physics, Kiev). Lett. Nuovo Cim.; 6: No. 5, 185-188(3 Feb 1973).

The method based on the Huygens' principle and the eikonal approximation are used to describe hadron collisions at high energies. The wave function is expressed in a form which directly reflects the diffractive character of the scattering at high energies. (LBS)

18443 LINE-REVERSAL SYMMETRY IN THE HIGH-ENERGY SCATTERING OF ELEMENTARY PARTICLES. Fialkowski, Krzysztof. Zesz. Nauk. Univ. Jagiellon., No. 288, Pr. Fiz.; No. 10, 7-62(1972). (In Polish).

The role and the applicability limits of the line-reversal symmetry in high-energy scattering are discussed. The symmetry rules are derived from general assumptions about scattering amplitudes. The Regge pole models in the one- and two-pole approximation with exchange degeneracy are discussed as examples of models fulfilling these assumptions. The connection between exchange degeneracy and duality is considered in the framework of the additive quark model. The properties of physical amplitudes are derived from the duality assumption for quark amplitudes. The existing data for cross sections, polarization and density matrices of resonances produced in line-reversal symmetric pairs of reactions are collected and used for checking the applicability of symmetry. The analysis of the data shows the existence of symmetry breaking terms. One observes the systematic inequalities between symmetric meson-baryon cross sections and non-zero polarizations of different magnitude for outgoing baryons. The energy dependence of total cross-sections is also inconsistent with exchange degeneracy. The simple Regge pole model with exchange degeneracy breaking or secondary trajectories do not explain these effects. The absorption corrections seem to be also inadequate. The quark model including three-quark interactions is proposed. It explains in a simple and natural way all the main features of observed effects. They are: i. systematic inequalities between cross sections, ii. the momentum-transfer dependence of quoted differences. iii. connection between the magnitude of the line-reversal symmetry breaking effect and the phase of amplitude, iv. spin effects, and v. energy dependence of nucleon–nucleon and kaon-nucleon total cross sections. It is concluded that, at the moment, the proposed model is the only on which explains and describes correctly the line-reversal symmetry breaking effects. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 18532.

18444 (COO-3130-TA-272) DUAL $\pi\pi$ PARTIAL-WAVE AMPLITUDES. I. THRESHOLD BEHAVIOR. Chung, B.K.; Feldman, D. (Brown Univ., Providence, RI Dept. of Physics). 1971. 19p. Dep. NTIS.

A formulation of the integral representations of the dual $\pi\pi$ partial-wave amplitudes is presented. One of the many advantages of these representations is that one can extract the threshold coefficients without difficulty. This is demonstrated in a calculation of the scattering lengths and effective ranges for the s, p, d, and f waves. (auth)

18445 (COO-3130-TA-273) DUAL $\pi\pi$ PARTIAL-WAVE AMPLITUDES. II. ASYMPTOTIC BEHAVIOR. Chung, B.K.; Feldman, D. (Brown Univ., Providence, RI Dept. of Physics). 1971. 22p. Dep. NTIS.

The integral representations, developed for the partial waves of the dual $\pi\pi$ amplitudes, are used to show that all the partial waves can be expressed as sums involving s waves only, and to prove that the isospin-zero and -two partial waves are bounded by powers in the right-half plane of the energy-squared variable and diverge exponentially along any ray in the left-half plane, thus confirming the behavior conjectured by Tryon. For the isospin-one waves, the derived bounds agree with those of Park and Desai. It is also proved that the discontinuities of the isospin-zero and -two partial waves diverge exponentially along the left-hand cuts and those for the isospin-one case are bounded by a power. (auth)

18446 (JINR-E2-6847) SPIN EFFECTS AT VERY HIGH ENERGIES AND $X^0(960)$ MESON. Bujak, A.; Filippov, A. T.; Ogievetskii, V. I.; Zaslavskii, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 7p. Dep. NTIS (U. S. Sales Only).

A Regge trajectory is discussed on which the $X^0(960)$ meson can lie if its spin-parity is 2^-. The intercept of this X trajectory would be $\alpha(0) = 1$ as for the pomeron. Such a possibility is not excluded by the experimental data available. The X pole exchange results in spin effects in elastic pp scattering at very high energies which may explain the marked slope parameter change observed recently in the ISR experiment. (auth)

18447 (NYO-2262-TA-250) LOW ENERGY LIMIT OF THE SIGMA MODEL. Guralnik, G.S.; Tsao, H.S.; Wong, T.F. (Brown Univ., Providence, RI Dept. of Physics; State Univ. of New York, Stony Brook. Dept. of Physics; Rutgers-The State Univ., New Brunswick, NJ). 1973. AT(11-1)-3130. 60p. Dep. NTIS.

We study the nonanalytic corrections in a renormalized linear σ model in the one loop approximation. Although we observe these corrections [of the form $\ln m_\pi^2$, $m_\pi^2 \ln m_\pi^2$, $(\not{p} - m) \ln m_\pi^2$, $(\not{p}_1 - m)(\not{p}_2 - m) \ln m_\pi^2$] as predicted by Li and Pagels in individual diagrams, yet they sum up to zero in the physically interesting amplitudes (pion and nucleon propagators, $\pi\pi$ and πN scattering amplitudes). We conclude that the nonanalytic correction is of higher order and thus does not invalidate the low energy results derived from phenomenological Lagrangian. (auth)

18448 SINGULARITY PROBLEM OF REGGE-POLE THEORY. Szego, K.; Toth, K. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 193-8(1972).

Reggeization of the unequal-mass scattering amplitude is examined. It is shown that there is a proper continuation to $s = 0$ of the Poincaré expansion of the scattering amplitude which does not lead to singularity and which is compatible with the dispersion relation and Regge behavior. (auth)

18449 SIMPLE EXTENSION OF THE ANALOG MODEL TO THE CASE OF SCALAR CURRENTS. Patkos, A. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 165-176(1972).

An off-mass-shell continuation of the dual multiparticle amplitude is constructed in the analog model for scalar particles. It is invariant under the SL (2; R) group, factorizable in the direct channel and the hadronic form factor has a reasonable asymptotic behavior; analytic properties, however, are not satisfactory. In the scaling limit the two-current amplitude shows an automatic cut-off in the transversal momentum, which is proportional to the momentum transfer (not fixed), so that an anomalous dimension appears in the model. (auth)

18450 COUPLED ANGULAR MOMENTUM CHANNELS AND AXIAL-VECTOR RESONANCE IN $\pi\omega$ SCATTERING. Shen, P.; Kang, K. (Brown Univ., Providence). Phys. Rev., D; 7: No. 1, 269-273(1 Jan 1973).

The possibility of binding an axial-vector meson in the $\pi\omega$ system is considered. A substantial admixture of s and d waves is required to bootstrap this particle, and the decay angular distribution calculated is in good agreement with the recent experimental information. (auth)

18451 UPPER LIMIT TO THE $A_2 \to \eta'\pi$ DECAY MODE. Eisenstein, L.; Schultz, P. F.; Ascoli, G.; Ioffredo, M. L.; Hansen, J. D. (Univ. of Illinois, Urbana). Phys. Rev., D; 7: No. 1, 278-279(1 Jan 1973).

An upper limit to the branching ratio $(A_2 \to \eta'\pi)/(A_2 \to \rho\pi)$ is determined at the 90% confidence level to be 0.011. (auth)

18452 PHENOMENOLOGICAL SIX-PION AMPLITUDE. Brower, R.; Chu, G. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 7: No. 1, 56-63(1 Jan 1973).

To test the multiparticle, zero-width bootstrap, a six-pion amplitude was constructed by modifying the general chiral pion amplitudes of Neveu, Schwarz, and Thorn. It is shown that imposing the chiral constraints to the six-pion dual amplitude does not fix the mass of the ω. The masses and widths of the low-mass resonances (e.g., ρ, ω, f, A_2, g, A_1, H, σ, and π') are given in terms of two masses (m_π and m_ω), one coupling ($g^2 \sim \Gamma_\rho$), and a universal trajectory slope (α'). $\Gamma(\omega \to 3\pi) = 6$ MeV, $\Gamma(A_1 \to \rho\pi) = 154$ MeV, and $\Gamma(A_2 \to \rho\pi) = 7.5$ MeV are estimated. Further phenomenological investigations are recommended. (auth)

18453 PION–PION PHASE SHIFTS FROM COVARIANT PERTURBATION THEORY FOR A CHIRAL INVARIANT FIELD THEORETIC MODEL. Ecker, G.; Honerkamp, J. (CERN, Geneva). Nucl. Phys.; B52: No. 1, 211-220(1973).

The Lehmann model for pion–pion scattering consists of a low-energy expansion of the scattering amplitude to fourth order in the momenta on the basis of the chiral-invariant pion-nucleon Lagrangian. Because of the nonrenormalizability of the pion Lagrangian two parameters remain undetermined in the pion-loop contribution. Using covariant perturbation theory and superpropagator methods, these two parameters are calculated independently of the choice of the pion field coordinates. The resulting phase shifts are shown to be in very good agreement with the data. (auth)

18454 SECOND-ORDER EFFECTS IN CHIRAL-INVARIANT PION LAGRANGIANS AND THE USE OF SUPERPROPAGATORS. Lehmann, H.; Trute, H. (Univ., Hamburg). Nucl. Phys.; B52: No. 1, 280-291(1973).

We examine the second-order corrections to the scattering amplitude and to the vector currents for chiral-invariant Lagrangians of massless pions. Standard renormalization theory leads to three undetermined parameters. We discuss the possibility of choosing definite values for these parameters by applying the technique of superpropagators. In an appendix we investigate the restrictions which follow if localizability of the perturbation expansion in powers of the interaction Lagrangian is required. It is shown that this condition determines the pion-field coordinates uniquely. (auth)

18455 HELICITY CONSERVATION AND TENSOR–MESON DOMINANCE. Kafiev, Yu. N.; Serebryakov, V. V. (Inst. of Mathematics, Novosibirsk, USSR). Nucl. Phys.; B52: No. 1, 141-154(1973).

The connection between the pomeron (P) and f-meson is investigated on the basis of tensor-meson dominance. It is shown that in an elastic vertex of arbitrary spin, tensor meson dominance (TMD) and s-channel helicity conservation (SCHC) of the pomeron leads to P–f proportionality. In diffraction dissociation it is shown generally that TMD gives nothing for helicity amplitudes, and the question whether the vertex is SCHC or TCHC is open. A model is constructed which allows one to answer this question in some particular reactions; ρ–f exchange degeneracy and predictions of SCHC for electromagnetic properties are discussed. (auth)

18456 KINEMATICS OF INCLUSIVE EXPERIMENTS WITH UNSTABLE PARTICLES. Kopylov, G. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; B52: No. 1, 126-140(1973).

The problem of the reconstruction of the longitudinal or transverse momenta spectrum of the π^0 mesons with detection of only one decay γ is solved. The formulas for the moments of this distribution are derived. The results are valid for arbitrary isotropic two- or many-particle decays. The Yen-Berger effect in the decay of resonances is estimated. (auth)

18457 BARYON–ANTIBARYON PHASE TRANSITION AT HIGH TEMPERATURE. Cisneros, A. (California Inst. of Tech., Pasadena). Phys. Rev., D; 7: No. 2, 362-367(15 Jan 1973).

Present experimental data on nucleon–antinucleon scattering allow a study of the possibility of a phase transition in a nucleon–antinucleon gas at high temperature. Estimates can be made of the general behavior of the elastic phase shifts without resorting to theoretical derivation. A phase transition which separates nucleons from antinucleons is found at about 280 MeV in the approximation of the second virial coefficient to the free energy of the gas. A rigorous treatment of the contribution of the inelastic channels remains, however, a difficulty. (auth)

18458 SIMPLE MODEL FOR THE LOW-ENERGY PION–PION SCATTERING FROM CURRENT ALGEBRA AND DISPERSION RELATIONS. Ghika, G. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 10, 1177-1186(1972).

A model of low energy pion–pion scattering amplitudes is constructed which is consistent with elastic unitarity and current algebra constraints. The N/D method is used, approximating the

left hand singularities by poles. The pole structure is determined self consistently by crossing symmetry at s = 0. The a^2 scattering length is calculated assuming that a^0 is known, and also an anti-bound state in the l = 0, T = 2 partial wave is found. (auth)

18459 INVERSE S-WAVE SCATTERING PROBLEM FOR A CLASS OF POTENTIALS DEPENDING ON ENERGY. Jaulent, M.; Jean, C. (Departement de Physique Mathematique, Montpellier, France). Commun. Math. Phys.; 28: No. 3, 177-220(1972).

The inverse scattering problem is considered for the radial s-wave Schrödinger equation with the energy-dependent potential $V^+(E,x) = U(x) + 2\sqrt{E}Q(x)$. (Note that this problem is closely related to the inverse problem for the radial s-wave Klein-Gordon equation of zero mass with a static potential.) Some authors have already studied it by extending the method given by Gel'fand and Levitan in the case Q = 0. Here, a more direct approach generalizing the Marchenko method is used. First, the Jost solution $f^+(E,x)$ is shown to be generated by two functions $F^+(x)$ and $A^+(x,t)$. After introducing the potential $V^-(E,x) = U(x) - 2\sqrt{E}Q(x)$ and the corresponding functions $F^-(x)$ and $A^-(x,t)$, fundamental integral equations are derived connecting $F^+(x)$, $F^-(x)$, $A^+(x,t)$ and $A^-(x,t)$ with two functions $z^+(x)$ and $z^-(x)$; $z^+(x)$ and $z^-(x)$ are themselves easily connected with the binding energies E_n^+ and the scattering "matrix" $S^+(E)$, E > 0 (the input data of the inverse problem). The inverse problem is then reduced to the solution of these fundamental integral equations. Some specific examples are given. Derivation of more elaborate results in the case of real potentials, and applications of this work to other inverse problems in physics will be the object of further studies. (auth)

18460 DOES AN F-MESON BEHAVE LIKE A MASSIVE GRAVITON? Takeda, G.; Itabashi, K.; Akiba, T. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2077-2081 (Dec 1972).

We study the reaction $\pi^-p \to f^0n$ to see whether an f-meson couples to the conserved energy momentum tensor and thus behaves like a massive graviton. Detailed experiments on the differential cross sections for the reaction $\pi^-p \to f^0n$ at extremely small momentum transfers and large energies seem to be useful to answer the question. (auth)

18461 EFFECTIVE PARAMETERS OF RESONANCES. Blazek, M.; Bohacik, J. (Inst. of Physics, Bratislava). Acta Phys. Austr.; 35: No. 4, 365-370(1972).

The energy dependent width in the denominator of the Breit–Wigner amplitude is explained in the neighborhood of the resonance. Retaining only the first order term, the correction of the mass and width is obtained, thereby allowing to introduce an effective mass and an effective width of the resonance. The formulas are applied to $\pi\pi \to \pi\pi$ and $\pi N \to \pi N$ in the zero angular momentum state. Simple explanation is given for the existence of the difficulties connected with the determination of the mass and width of the dipion state with $I^GJ^P = 0^+0^+$. Some other discrepancies concerning the value of the resonance parameters might be explained by this method as well. Several generalizations are suggested. (auth)

18462 CURRENT ALGEBRA CALCULATIONS WITH ON-MASS-SHELL MESONS. Golestaneh, A. A. (Univ. of Maryland, College Park); Carlson, C. E. Nuovo Cim.; 13A: No. 2, 514-525(21 Jan 1973).

In this paper we consider some questions related to current algebra calculations with on-mass-shell pions. For performing such calculations we work with an axial current which satisfies $\partial_\mu J^\mu = c(\partial^2 + m^2)\varphi$. (Here φ, m, and c are the meson's field, mass and decay constant.) Such a current is related to the usual axial current by the addition of a term proportional to the derivative of the meson field; the quoted equation corresponds to PCAC. We show in the σ-model that the new current still has the usual closed chiral commutation relations, and display a Lagrangian from which the modified current can be derived via a gauge principle. (auth)

18463 FUNCTIONAL CALCULUS HAVING APPLICATIONS IN THE VENEZIANO MODEL. Dittrich, W. (Univ., Tuebingen, Ger.). Nuovo Cim.; 13A: No. 2, 541-555(21 Jan 1973).

Functional methods are used to present a neutral scalar field theory with duality. In particular the closed-form Green's function of the dual-resonance model is derived using nonperturbational techniques. The Veneziano propagator with self-energy correction is derived by expanding the propagation function in a power series of the coupling constant. The theory uses a model for the internal structure of the meson in which the meson is bound by purely harmonic forces. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 18333 and 18539.

18464 (JINR-P2-6858) ENERGY SPECTRA AND PROTON POLARIZATION IN pd → ppn REACTION AT 600 MeV. Golovin, B. M.; Lykasov, G. I.; Rozanova, A. M.; Khamraev, F. Sh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results are presented of the calculation of energy spectra and proton polarization in the pd → ppn reaction at T_p = 600 MeV taking account of the effects of incident particle rescattering by deuteron nucleons. (auth)

18465 (LBL-1065) PARTIAL WAVE ANALYSIS OF THE REACTION $\pi N \to \pi\pi N$ IN THE cm ENERGY RANGE 1300 TO 200 MeV. Herndon, D. J.; Longacre, R.; Miller, L. R.; Rosenfeld, A. H.; Smadja, G.; Soding, P.; Cashmore, R. J.; Leith, D. W. G. S. (California Univ., Berkeley. Lawrence Berkeley Lab.; Stanford Linear Accelerator Center, Calif.). 25 Aug 1972. Contract W-7405-eng-48. 49p. (CONF-720923-11; SLAC-PUB-1108). Dep. NTIS.

A continuous set of partial wave amplitudes (in the c.m. energy range 1300 to 2000 MeV) is presented. A D13 (~1700) state is observed in two channels, the existence of a P13 (~1800) is corroborated, but there is little evidence for a P33 (1700). The presence of many resonances in the channels $N\rho$ and $N\sigma$ are observed, supplementing the information on their $\pi\Delta$ decays. (auth)

18466 (UCR-34-P-107-132) PARTIAL WAVE ANALYSIS OF $\pi^+p \to \pi^0\Delta^{++}(1236)$ IN THE CENTER OF MASS ENERGY REGION 1820 TO 2090 MeV. Mehtani, Usha (California Univ., Riverside). Dec 1971. 92p. Dep. NTIS.

Thesis.

The differential cross sections $d\sigma(\cos\theta_s)/d\Omega$ and Δ density matrix elements $\rho_{33}(\cos\theta_s)$, Re $\rho_{31}(\cos\theta_s)$ and Re $\rho_{3,-1}(\cos\theta_s)$ for the reaction $\pi^+p \to \pi^0\Delta^{++}(1236)$ were measured at seven incident momenta 1.28, 1.34, 1.42, 1.55, 1.67, 1.77 and 1.84 GeV/c. With these experimental data, an energy-dependent partial wave analysis of this reaction was performed. It was found that the inelastic channel $\pi N \to \pi\Delta$ is dominated by F_{37} (1950) resonance with the branching fraction parameter $x_{\pi N}x_{\pi\Delta} = 0.25^{+0.0}_{-0.10}$. Other partial wave amplitudes which are strong in this energy interval are FF5, PP1, DD5, PP3 and SD1. Phase shift analysis in the elastic channel shows the presence of the $F_{37}\Delta(1950)$ resonance and suggests the existence of three other resonances $F_{35}\Delta(1890)$, $P_{31}\Delta(1910)$ and $D_{35}\Delta(1960)$. Of the latter three resonances only $P_{31}(1910)$ is indicated by the data with $x_{\pi N}x_{\pi\Delta} \approx 0.04$. The reaction $\pi^+p \to \pi^0\Delta^{++}$ goes by pure ρ exchange in the t-channel. All the angular distributions have features characteristic of Regge ρ trajectory exchange, i.e., they have dips at $t \approx 0$ and $t \approx -0.5$ $(GeV/c)^2$. The s-channel partial wave amplitudes were projected from the Regge ρ amplitude. The F_{37} amplitude, which is predominant in the s-channel, is negligible here. Also P_{31} is insignificant in the ρ amplitude. However, suggestive similarities are observed between the partial wave fits and the s-channel projections of the Regge ρ amplitude. (auth)

18467 ISOBAR MODELS, ANALYSIS, AND SYMMETRIZATION EFFECTS IN MESON + BARYON → MESON + MESON + BARYON. Capps, C. D.; Madden, P. B.; Williams, P. K. (Florida State Univ., Tallahassee). Phys. Rev., D; 7: No. 1, 146-162(1 Jan 1973).

A study of helicity formalisms was made for two-body → three-body reactions. An improvement in the formalism of Namyslowski, Razmi, and Roberts, both in accuracy and in manageability, is presented. Also, the results of an application of the formalism to the reaction $K^-n \to \Sigma^+\pi^-\pi^-$ are presented in an isobar model with sequential decays through intermediate Λ and Σ resonances. Some appreciable effects due to boson symmetrization are found. (auth)

18468 THEORY OF DEVIATIONS FROM PION POLE DOMINANCE. Brandt, R. A. (New York Univ., NY); Preparata, G. Phys. Rev., D; 7: No. 1, 218-229(1 Jan 1973).

It is shown how mass dispersion relations can be effectively used to quantitatively determine the effects of extrapolating an amplitude off the mass shell. Light-cone operator-product expansions abstracted from the canonical gluon model are used to determine the asymptotic behavior in the mass variable. This determination is made quantitative via the principles of precocious asymptopia and smooth threshold behavior. These techniques are used to calculate some corrections to pion pole dominance for vertex functions and scattering amplitudes in the weak PCAC (partially conserved axial-vector current) framework. Corrections to kaon pole dominance and to SU(3) symmetry are determined in the course of the analysis. Put differently, some measurable consequences of broken SU(3) × SU(3) symmetry are determined. The canonical equal-time and light-cone operator algebraic structures are presumed to be exact, but the physical states (and hence on-shell S-matrix elements) may exhibit considerable, but now controllable, deviations from the underlying

SU(3) × SU(3) symmetry. As explicit examples of the methods, the K_{l3} form factors $f_\pm(q^2)$ and the symmetric and antisymmetric πN scattering amplitudes are discussed in detail. The numerical results are: $f_+(0) \cong 1.0$, $\xi(0) \equiv f_-(0)/f_+(0) \cong -0.7$, $f_+(m_K^2) + f_-(m_K^2) \cong (0.7) \times f_K/f_\pi$, α_8 = [SU(3)-breaking parameter] $\cong -140$ MeV, σ_N = (πN σ term) ~ 450 MeV, $g_A \sim 1.23$. The results for πN scattering confirm and extend the previous weak PCAC analysis, based on Regge theory, but some of the K_{l3} results are now different. The good result $\xi(0) \sim -0.7$ is, however, maintained and is now obtained without any assumption about the q^2 dependence of $f_\pm$. None of the present results involved assumptions of smooth off-shell behaviors of Green's functions. In all cases the mass dispersion relations were used to compute the effects of off-shell extrapolations. (auth)

18469 NEW FINITE-ENERGY SUM RULES BASED ON ρ AND ω EXCHANGE. Lipkin, H. J. (Argonne National Lab., IL). Phys. Rev., D; 7: No. 1, 237-242(1 Jan 1973).

New finite-energy sum rules relate the isospin dependence of low-energy s-channel amplitudes to the ratio of ρ- and ω-exchange contributions in the Regge region. Applications to NN, KN, KΔ, and NΔ scattering are discussed. Results include the isospin dependence of $\bar{N}N$ annihilation, SU(6) symmetry breaking in the couplings of strange baryon resonances to the KN system, and predictions for exotic production in Δ-exchange reactions. (auth)

18470 DISPERSION SUM RULES FOR $\Sigma\Lambda$ TRANSITION MAGNETIC MOMENT. Mallik, S. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev., D; 7: No. 1, 284-287(1 Jan 1973).

Sum rules are considered for the process $\pi\Lambda \to \pi\Sigma$ obtained by equating the fixed-t and the fixed-u dispersion relations for the invariant amplitudes at a suitable point. The sum rules relate the transition magnetic moment for $\Sigma \to \Lambda + \gamma$ to the contributions from s-channel singularities. The results obtained are in agreement with the predictions of SU(3) and SU(6) symmetry. (auth)

18471 PROTON DISTRIBUTIONS IN HIGH-ENERGY PROTON–PROTON COLLISIONS. Slansky, R. (Yale Univ., New Haven). Phys. Rev., D; 7: No. 1, 80-86(1 Jan 1973).

The spectrum of protons in proton-proton collisions is analyzed in terms of a fragmentation model. Particular attention is devoted to the strength of the isobar production and the energy dependence of the background. The model reproduces the shape and energy dependence of the proton spectrum in a very detailed way. Some problems of identifying production mechanisms from these data are discussed. (auth)

18472 CRITICISM OF THE ACCELERATED-CONVERGENCE-EXPANSION PARTIAL-WAVE ANALYSIS OF K^+p ELASTIC SCATTERING. Griss, M. L.; Fox, G. C. (California Inst. of Tech., Pasadena). Phys. Rev., D; 7: No. 1, 74-80(1 Jan 1973).

The accelerated-convergence-expansion (ACE) method of phase-shift analysis has been applied recently to K^+p elastic scattering. Its conformal-mapping technique generates larger high partial waves (HPW) than previous analyses. The HPWs are calculated from π-exchange, and estimate all possible uncertainties. The results are much smaller than and in clear contradiction with the ACE predictions for the HPWs. Modifications of the latter are suggested to remedy this sad state of affairs. (auth)

18473 PROBLEM OF THE RELATION BETWEEN DOUBLE POMERON EXCHANGE IN INCLUSIVE AND EXCLUSIVE EXPERIMENTS. Mehta, C. H. (Univ. of California, San Diego, La Jolla); Silverman, D. Nucl. Phys.; B52: No. 1, 77-95(1973).

The pionization region of the inclusive single-particle spectrum is accounted for by double pomeron exchange in the absorptive part of a six-point amplitude. A multiperipheral model for the six-point amplitude with double pomeron exchange is used for continuation by crossing and analyticity to the physical region of the exclusive two particle → four particle production process. The cross section for $\pi^-p \to \pi^-(\pi^+\pi^-)p$ in the double-Regge region is then calculated and compared with the experimental analysis of Lipes, Zweig and Robertson which sets an upper bound to the strength of the double pomeron exchange coupling. This upper bound, coupled with the model for continuation to the inclusive cross section, is shown to give too small a magnitude for the double pomeron exchange in the pionization region. Further avenues for investigation are discussed. (auth)

18474 TRANSIENT PHENOMENA AT INTERMEDIATE ENERGIES. Odorico, R. (Argonne National Lab., IL). Nucl. Phys.; B52: No. 1, 248-252(1973).

Considering the experimental energy behaviors of elastic K^+p, pp, πp polarizations, it is shown that in helicity-flip amplitudes nonleading contributions, nonidentifiable with absorptive corrections, Regge–Regge cuts or resonance tails, remain nonnegligible up to ~10 GeV/c. The interpretation of such contributions appears uncertain. (auth)

18475 INELASTIC $\pi p \to \Lambda(\Sigma)K$ REACTIONS ALLOWING FOR THE CONTRIBUTION OF BRANCHING. Ter-Ovanesov, E. F. (Smolensk Pedagogical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 26-30(1972). (In Russian).

An analysis of experimental data on the inelastic reactions $\pi p \to \Lambda(\Sigma)K$ was made within the framework of complex momenta allowing for branching in the j-plane in the eikonal approximation. An optical model for backward scattering was considered. Agreement with experimental values was obtained for the reaction $\pi^-p \to \Lambda(\Sigma^0)K^0$ in the region of small angles, and for the processes $\pi^-p \to \Lambda K^0(\Sigma^-K^+)$ at large (~180°) scattering angles. (tr-auth)

18476 SPECTROSCOPIC CONSEQUENCES OF EXACT DUALITY FOR BARYONS. Rosner, J. L. (Univ. of Minnesota, Minneapolis). Phys. Rev., D; 7: No. 1, 172-185(1 Jan 1973).

Those backward meson-baryon scattering and (baryon + antibaryon → two mesons) processes which are exotic in the direct channel are assumed to be dominated at high energy by the exchange of baryon trajectories whose imaginary parts cancel exactly. A solution of these constraints in accord with the lowest-lying baryon states is obtained; the residue ratios are found to vary along the trajectory. Properties of a $J^P = 7/2^+$ baryon octet in the mass range 1950–2200 MeV, predicted by these constraints, are examined. For example, one expects (a) a $J^P = 7/2^+$ N(1950) with $\Gamma(\pi N) \simeq 13$ MeV and $\Gamma(\pi\Delta) \simeq 80$ MeV, whose effects might also be visible in $\pi N \to K\Sigma$, and (b) a $J^P = 7/2^+$ Δ(2100), with $\Gamma(\Sigma\pi) \simeq 22$ MeV and $\Gamma(\Sigma(1385)\pi) \simeq 60$ MeV, whose $\bar{K}N$ coupling should be very small. A further prediction is that of a G_{39} πN resonance, $\Delta(2200)$ ($J^P = 9/2^-$), whose effects could be visible in backward π^+p scattering. (auth)

18477 BEHAVIOR OF THE TRANSVERSE MOMENTUM IN PION–NUCLEON INTERACTIONS AT HIGH ENERGY. Balea, O. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 7, 811-844(1972). (In Rumanian).

After a general introduction, present-day investigations on the transverse momentum problem are reviewed; these include the transverse-momentum distribution function; the dependence of the average transverse momentum on primary energy, particle mass, and reaction multiplicity; and the correlation between the average transverse momentum and cms longitudinal momentum. There follows a study of the average transverse and cms longitudinal momentum correlation. The evidence for the average transverse and cms longitudinal momentum correlation in π^- + p interactions at 7.5 GeV is examined: the phase-space predictions for the average transverse and cms longitudinal momentum correlation; the average transverse and cms longitudinal momentum correlation in $\pi^\pm$ interactions with strange particle production at 4 and 8 GeV; the average transverse and cms longitudinal momentum correlation in π^- + p interactions with strange particle production at 7.5 and 20 GeV. Observations on the average transverse momentum behavior are presented: dependence of the average transverse momentum on the primary energy, particle mass, and reaction multiplicity, and a new parametrical formula for the estimation of average transverse momentum. Seven conclusions drawn from this work are listed. (33 figures, 8 tables) (RWR)

18478 RELATIVISTIC THREE-BODY PROBLEM. Namyslowski, J. (Univ., Warsaw). Zesz. Nauk. Univ. Jagiellon., No. 231, Pr. Fiz.; No. 8, 91-97(1970).

A lecture is presented in which a method is given for building an approximate dynamical theory of three relativistic particles which enable one to calculate production processes such as $\pi + N \to 2\pi + N$. (JFP)

18479 SUPERCONVERGENCE AND FINITE ENERGY SUM RULES. Kwiecinski, J. (Inst. of Nuclear Physics, Krakow). Zesz. Nauk. Univ. Jagiellon., No. 231, Pr. Fiz.; No. 8, 31-35 (1970).

A lecture is given on the foundation and some applications of the superconvergence relations and their generalization for the finite-energy sum rules. The amplitudes for meson–baryon and $\pi + N$ interactions are discussed. (JFP)

18480 MODEL-INDEPENDENT TEST OF THE ADLER–WEISBERGER SUM RULE FOR KAONS. Lopez, C. (Univ. Autonoma, Madrid). Nucl. Phys.; B52: No. 1, 169-172(1973).

A test of the Adler–Weisberger sum rule for kaons is performed. To evaluate the integral over the unphysical cut, the model-independent results obtained previously by Yndurain and the author are used. The value of $|g_A^A|$ given by the Adler–Weisberger rule assuming positivity for the absorptive part of the elastic amplitude K^-p below the threshold is 0.67 ± 0.06, to be compared with the experimental value 0.66 ± 0.06. (auth)

18481 EXACT UPPER BOUND FOR PION—NUCLEON COUPLING CONSTANT. Okubo, S. (Univ. of Rochester, NY). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1986-2007(Dec 1972).

An exact upper bound for pion-nucleon coupling constant g which has been originally discovered by Geshkenbein and Ioffe has been rederived without assuming numbers of subtractions for spectral representation of $S_F'(p)$. Also, it has been proved that their bound is violated if and only if the ghost-like pole discussed by Goebel and Sakita appears, when $S_F'(p)$ has one zero point. It is computed that the bound leads to $g^2 \leq 20$ in the exact SU(3) limit, which is very close to the experimental value $g^2 = 15$. The d and f coefficients of baryon-meson octet coupling constants are shown to be restricted to $0.30 \leq d \leq 0.94$. Also, the renormalization constant Z_2 of the nucleon must satisfy $0.85 \geq Z_2 \geq 0$, irrespective of any dynamical detail. (auth)

18482 VENEZIANOIZED SHORT-RANGE POTENTIAL AND THE (3,3)-πN RESONANCE. Imoto, M. (Nihon Univ., Narashino, Japan). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1923-1933 (Dec 1972).

By using the Venezianoized short range potential in addition to the long range potential, the position of the 33πN resonance is determined. It is shown that this Venezianoized short range potential is repulsive and is important to produce the 33πN resonance. The pole-cut duality is shown in the scheme of the Mandelstam representation with the strip approximation. (auth)

18483 MESON–NUCLEON SIGMA-TERM AND THE $\bar{B}BS$-COUPLING CONSTANTS. Sinha, K. K. (Regional Engineering Coll., Durgapur, India); Gautam, V. P. Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2116-2118(Dec 1972).

An expression for the sigma term in meson–nucleon scattering was previously derived. For its numerical estimation the values of the $\bar{B}BS$ coupling constants are required. These coupling constants are determined using different values of the sigma terms obtained previously as input. (JFP)

18484 DUAL MODEL WITH SECOND-SHEET RESONANCES FOR PION–NUCLEON SCATTERING. Joshi, G. C.; Wignall, J. W. G. (Univ. of Melbourne). Nuovo Cim.; 13A: No. 2, 483-498(21 Jan 1973).

A crossing-symmetric pion-nucleon scattering amplitude with Regge behavior and second-sheet resonance poles is constructed using suitable combinations of a representation proposed by Cohen–Tannoudji, Henyey, Kane and Zakrzewski (CHKZ). The Regge residues for high energy scattering are obtained in terms of the function f(t) which is used in construction of the CHKZ representation. An attempt is made to find the form of f(t) which gives the best fit to the high energy charge-exchange differential cross section in the forward direction. It is also shown that the nucleon pole term imposes restrictions on the location of the branch point of f(t), and that the fit at large |t| can be improved by modifying the ρ trajectory function so that it satisfies the bound $|\alpha_\rho(t)| < |C|t|^{\frac{1}{2}} \log |t||$ for $t \to -\infty$. (auth)

18485 K MESON–NUCLEON INTERACTION. Bransden, B. H. (Univ. of Durham, Eng.). pp 1-107 of High Energy Physics. Vol. III. Burhop, E. H. S. (ed.). New York; Academic Press, Inc. (1969).

The chapter is particularly concerned with a description of the analysis of low-energy K^+- and K^--nucleon scattering and of the more important reactions in the resonance region, which extends to K-meson energies of some 2 or 3 GeV. (LBS)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 18857 and 19050.

18486 (COO-3001-27) TWO-PION-EXCHANGE ΛN POTENTIAL. Riska, D. O. (State Univ. of New York, Stony Brook. Dept. of Physics). 1972. Contract AT(11-1)-3001. 58p. Dep. NTIS.

The two-pion-exchange contribution to the ΛN potential is constructed from the field theoretic scattering amplitude. The potential is constructed both for a single channel description of the ΛN interaction and for a coupled channel treatment of the ΛN and ΣN interactions. One resulting TPE ΛN matrix element is real and weakly energy dependent up to threshold for π production in the coupled channel framework. We take into account the Adler consistency condition for the input $\pi\Lambda$ and πN amplitudes, as well as the s-wave $\pi\pi$ interaction. The rescattering effects in the intermediate state are approximated by the low mass πB resonances in the sharp resonance approximation. (auth)

18487 (COO-3001-31) PARITY VIOLATING TWO-PION-EXCHANGE NUCLEON–NUCLEON POTENTIAL. Pirner, H. J.; Riska, D. O. (State Univ. of New York, Stony Brook. Dept. of Physics). 1972. Contract AT(11-1)-3001. 13p. Dep. NTIS.

The isovector part of the parity-violating two-pion-exchange NN potential is constructed from the field theoretic amplitude. The parity violating NN coupling is described by the phenomenological Lagrangian $g_w \bar{\psi}(\tau \times \phi)_3 \psi$, with $g_w = 3.2\ 10^{-8}$. The effect of p-wave $\pi\pi$ correlations is taken into account. (auth)

18488 (COO-3130-TA-269) MULTIPLICITY DISTRIBUTIONS RESULTING FROM MULTIPERIPHERAL PLUS DIFFRACTIVE PRODUCTION. Frazer, W.R.; Peccei, R.D.; Pinsky, S.S.; Tan, C.I. (California Univ., La Jolla, San Diego. Dept. of Physics; Stanford Univ., Calif. Dept. of Physics; California Univ., Riverside. Dept. of Physics; Brown Univ., Providence, RI Dept. of Physics). 1972. 39p. (UCSD-10-P-10-113). Dep. NTIS.

We discuss the phenomenology of multiplicity distributions in high energy hadronic collisions in terms of the short-range correlation picture, modified to include diffractive processes leading to low-multiplicity final states. We formulate two models, both of which give reasonable fits to present data on high energy partial cross sections. Model-independent methods for separating diffractive and multiperipheral production are discussed. (auth)

18489 (JINR-P2-6581) COHERENT AND INCOHERENT PARTICLE PRODUCTION ON NUCLEI IN THE MULTIPLE SCATTERING THEORY. Gevorkyan, S. R.; Zaimidoroga, O. A.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 22p. (In Russian). Dep. NTIS (U. S. Sales Only).

Particle production on nuclei is considered in the multiple scattering theory. Formulas valid in a wide range of energies and momentum transfers are derived. The theory is compared with experiment. (1 figure, 1 table) (auth)

18490 UNIFIED PICTURE OF PROTON–PROTON ELASTIC SCATTERING AT ALL ANGLES FROM 3 TO 24 GeV/c. Cheng, T. Y.; Chu, S. Y.; Hendry, A. W. (Indiana Univ., Bloomington). Phys. Rev., D; 7: No. 1, 86-90(1 Jan 1973).

An investigation was made of pp elastic scattering on the basis of smooth distributions for the helicity-nonflip and -flip amplitudes in the impact parameter b. It is shown how these distributions change with energy. Interpretations for the shrinkage of the forward diffraction peak, the break in $d\sigma/dt$ at $|t| \approx 1$ $(GeV/c)^2$, and the observed pronounced structure in the pp polarization are given. (auth)

18491 DIFFRACTIVE MODELS IN NONDIFFRACTIVE REGIONS. Lam, C. S. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Rev., D; 7: No. 1, 234-236(1 Jan 1973).

Within the spirit of fragmentation models, various quantities may be calculated only when behaviors in the nondiffractive regions are known. These include the dispersion of multiplicity distributions, the rate of approach to asymptotic limits, etc. A priori, very little can be said about the nondiffractive region in fragmentation models. However, if it is demanded that the invariant pion spectrum in pp inclusive collisions be flat in the central region, then information about the nondiffractive regions may be obtained. In particular, in the diffractive excitation model, this requires that the n^{-2} law be valid almost right up to the kinematical boundary, in a way to be specified in the test. (auth)

18492 ELASTIC NN AND Nd SCATTERING. Dumbrais, O. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 349-350(1972). (In Russian).

A unique elastic scattering of elementary particles, accessible for experimental measurement, characterizes elastic NN scattering, the particles belonging to the same isotopic multiplet. Certain supplementary relations between quantities were obtained which characterize elastic scattering. The relations developed were subject to Glauber's corrections; the effect of spin could be neglected at high energies, although certain deviations attested to the presence of "spin effects." (KSW)

18493 THREE-BODY CALCULATION FOR POLARIZATION EFFECTS IN NEUTRON–DEUTERON SCATTERING. Doleschall, P. (Univ., Helsinki). Nucl. Phys.; A201: No. 2, 264-288 (1973).

The Faddeev equations with separable two-particle interactions were solved for the 2n + p system at energies 14.1 MeV and 22.7 MeV respectively. The simultaneous and individual effect of the S- and P-wave interactions and the tensor force on the differential cross section and polarizations were studied. The experimental data were not reproduced satisfactorily. A method different from the contour-deformation method was suggested to treat the singularities of the kernels of the Faddeev integral equations. (auth)

18494 ANGULAR DISTRIBUTION OF PIONIZATION PARTICLES FROM CERN STORAGE-RING EXPERIMENTS. Jabs, A. (Joint Inst. for Nuclear Research, Dubna, USSR). Lett. Nuovo Cim.; 5: No. 17, 1087-92(23 Dec 1972). (In German).

A formula is given for the angular distribution of charged secondary particles from high-energy collisions in the pioniza-

tion region, and is used to fit the CERN ISR data on pp interactions carried out at c.m.s. energies of 20 to 50 GeV and at Θ = 20 to 90°. The dependence of the anisotropy parameters on the c.m.s. energies was also determined from the fit to the data. (LBS)

18495 TRANSPARENCIES OF COMPLEX NUCLEI TO PHOTOPRODUCED PIONS AND RECOIL NUCLEONS. de Carvalho, H. G.; (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Martins, J. B.; Tavares, O. A. P.; Nazareth, R. A. M. S.; Di Napoli, V. Notas Fis., Cent. Brasil. Pesqui. Fis.; 17: No. 4, 217-233 (1971).

The calculation of transparencies for pions and recoil nucleons originated by interaction of high energy photons with complex nuclei (energy range 0.3 GeV to 1.0 GeV) is described. (auth) (INIS)

18496 BETHE–SALPETER EQUATION FOR NUCLEON–NUCLEON SCATTERING MATRIX PADE APPROXIMANTS. Gammel, J. L.; Menzel, M. T. (Los Alamos Scientific Lab., NM). Phys. Rev., D; 7: No. 2, 565-568(15 Jan 1973).

It is first shown that the so-called "kernel subtraction" technique which was used in a previous paper on the Bethe–Salpeter equation is unnecessary. The simplified equations which result make it possible to introduce matrix Padé approximants in a straightforward way. These are found to converge to the same solution that was found in the previous work and more rapidly than the ordinary Padé approximants. (auth)

18497 GENERALIZED EIKONAL APPROXIMATION AND MULTIPLE-SCATTERING FORMALISM AT HIGH ENERGIES. Obu, M. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1934-1959(Dec 1972).

A formalism for high energy multiple-scattering is developed, which is similar to the Glauber formalism but does not assume the eikonal approximation. The time-dependent scattering theory is adopted to generalize this approximation. In the eikonal approximation together with the adiabatic one, the time-dependent interaction Hamiltonian in the interaction representation turns out to be commutative. This commutative nature of the eikonal approximation enables us to propose a generalized approximation which assumes the commutativity itself. The extended approximation is called the generalized eikonal approximation (GEA) and is used to develop the extended multiple-scattering formalism. In the GEA the trajectory of the incident particle may deviate from the straight line, the trajectory adopted in the Glauber theory. Therefore, the extended formalism can be considered to be more reliable at large angles than the Glauber formalism. (auth)

18498 MULTIPLICITY MOMENTS, CLUSTER FUNCTIONS, AND THE ASYMPTOTIC BEHAVIOR OF THE CROSS SECTION. Sivers, D.; Thomas, G. H. (Argonne National Lab., IL). Phys. Rev., D; 7: No. 2, 516-524(15 Jan 1973).

In the context of models which have a cluster decomposition in the momentum variable of the produced particles the effects of (1) small transverse momentum, (2) small average inelasticity, and (3) asymptotically constant total cross section are studied. Constraints on the behavior of the cluster functions for large rapidity separations and on the high-energy behavior of the multiplicity moments are found. (auth)

18499 EXPLICIT CALCULATIONS OF PROTON–PROTON SCATTERING TO ALL ORDERS IN THE GLAUBER–HARRINGTON–PAGNAMENTA MODEL. Klenk, K. F. (Lehigh Univ., Bethlehem, PA); Kanofsky, A. S. Nuovo Cim.; 13A: No. 2, 446-452(21 Jan 1973).

We have calculated the high energy proton–proton elastic-scattering cross section $d\sigma^+/dt$ using the methods developed by Glauber, and Harrington and Pagnamenta. Quark-quark scattering processes from single scatter out to the ninth, the highest-order scatter, have been included. The results indicate a slight break at about 9 $(GeV/c)^2$ where fourth and fifth scatters become significant. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 18259, 18545, 18836, and 19056.

18500 SYMMETRIES OF WIGNER COEFFICIENTS AND THOMAE–WHIPPLE FUNCTIONS. Huszar, M. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 181-5(1972).

Wigner coefficients of the three-dimensional rotation group can be brought into the form of Thomae–Whipple functions. The symmetry group of order 72, discovered by Regge, is a straightforward consequence of 6 forms of the 120 Thomae–Whipple functions. The question whether the remaining 114 forms of these functions lead to new symmetries is investigated. It is shown that if the Regge group is enlarged by the transformations $j \rightarrow -j-1$, a group or order 1440 is obtained, which is exactly the group generated by the interrelations between the 120 Thomae–Whipple functions. (auth)

18501 REPRESENTATION OF THE SYMMETRICAL GROUP S_n IN THE BASIS OF THE UNITARY GROUP U_{n-1} AND SOME RECOUPLING MATRICES OF U_3. Alishauskas, S. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 2, 211–16(1972). (In Russian).

The algebraic expression for the matrix elements of the transposition p_{n-1n} in Gelfand basis of the unitary group U_{n-1} is presented as well as explicit expressions for certain types of U_3 recoupling matrices, used in evaluation of orbital fractional parentage coefficients of nuclei. (auth)

18502 RELATIVISTIC DYNAMICAL SYMMETRIES AND DILATATIONS. Roman, P.; Aghassi, J. J.; Huddleston, P. L. (Boston Univ.). J. Math. Phys. (N.Y.); 13: No. 12, 1852-1861(Dec 1972).

Characterizing the state of a relativistic particle by a pair (χ_μ, ξ_μ) of 4-vectors, we are led, in a natural way, to a group $\mathfrak{C}_5$ of canonical transformations which includes the Poincaré group and dilatations. The structure of the group and its induced irreducible unitary representations are explored. It is shown that $\mathfrak{C}_5$ has a semisimple noncompact subgroup which permits a systematic treatment of exact and of broken dilatation symmetry. The relevance of these ideas to scale dimension and to a new symmetry, scale conjugation, is discussed. As an application, a mass formula is derived from broken dilatation symmetry. (auth)

18503 COMMENTS ON A MODEL OF SPONTANEOUSLY BROKEN SCALE INVARIANCE. Papastamatiou, N. J.; Umezawa, H. (Univ. of Wisconsin, Milwaukee). Phys. Rev., D; 7: No. 2, 571-574(15 Jan 1973).

Some interesting features of a model of spontaneously broken scale invariance examined previously by us are discussed and elaborated upon. In particular, a concrete illustration of the inequivalence of the commutator of the scale generator D with the weak limit of the Hamiltonian and the weak limit of the commutator of D and the Heisenberg Hamiltonian is presented. (auth)

18504 ALGEBRAIC REALIZATION OF CHIRAL SYMMETRY ON THE LIGHT CONE. Feinberg, F. L. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 7: No. 2, 540-549(15 Jan 1973).

Lightlike charge commutators are used to provide a new derivation of the algebraic realizations of chiral symmetry for pionic processes first found by Dashen, Fubini, and Gell-Mann and by Weinberg, a derivation which avoids the $p \rightarrow \infty$ limiting procedure. Also, the Gell-Mann–Okubo mass formula is obtained in a way that naturally gives the correct form for both bosons and fermions. In the appendixes, the light-cone commutator structure of some relevant models is discussed. (auth)

18505 SU(2) STATISTICAL WEIGHTS FOR MANY-PARTICLE SYSTEMS. Nicorovici, N. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 10, 1217-1219(1972).

A general formula is given for obtaining the SU(2) statistical weights in the case of a system composed of n particles with spins j_k $(k = 1,\ldots,n)$. (JFP)

18506 P, T, C PROPERTIES OF THE POINCARE INVARIANT EQUATIONS FOR MASSIVE PARTICLES. Fushchich, V. I. (Inst. of Mathematics, Kiev). Lett. Nuovo Cim.; 6: No. 4, 133-137 (27 Jan 1973).

The P, T, C properties of the Poincare-invariant equations for massive particles are investigated in the canonical representation. (LBS)

18507 SELF-CONSISTENT APPROACH TO SYMMETRY BREAKING. Rest, J. (Argonne National Lab., IL); Welling, D. J. Lett. Nuovo Cim.; 6: No. 4, 152-156(27 Jan 1973).

An approach to understanding the problem of symmetry and its breakdown within the context of a self-consistent quantum field theory is presented. Solutions to the dynamic field equations for interacting pseudoscalar field and a singlet scalar field are explored for a continuous range of the coupling constant. It is shown that for the case of exact symmetry the physical fields are found to transform linearly under the SU(3) group. It is also shown that as the symmetry breaking is turned off the physical pseudoscalar fields approach the linear transformations. (LBS)

Applications (Electromagnetic and Weak)

Refer also to abstract 18409.

18508 (JINR-P2-6820) NEUTRINO IN THE FRIEDMANN WORLD. Chernikov, N. A.; Shavokhina, N. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The conformal invariance of the neutrino behavior is proved. The postulate that the behavior of the massless particles should be described by the conformal invariant equations and that, in this case, the trace of the energy-momentum tensor is to be equal to zero is discussed. (auth)

18509 SPONTANEOUSLY BROKEN WEAK- AND ELECTROMAGNETIC-INTERACTION SYMMETRY AND THREE-TRIPLET MODEL FOR HADRONS. Mohapatra, R. N. (Univ. of Maryland, College Park). Lett. Nuovo Cim.; 6: No. 2, 53-57(13 Jan 1973).

An alternate formulation of the hadronic part of the Glashow–Georgi theory based on the three-triplet model of strong interactions is suggested. A natural extension of the Glashow–Georgi theory of weak interactions to the case of hadrons is possible within the three-triplet model. It is also shown that the usual current algebra remains valid in the model. The correct sign and magnitude of the $\pi^{-0} \rightarrow 2\gamma$ decay matrix element are given by this model. (JFP)

18510 CHECKING MICROSCOPIC CAUSALITY AND REVERSIBILITY IN K-MESON DECAY. Marx, G. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 323-40(1972).

The available experiments have indicated that neutral K decays violate CP and T symmetries, but conserve CPT symmetry, which is strictly related to local causality. The accuracy of this indication is discussed. The possibility that a stronger CP and T asymmetry existed at the time of the big bang is suggested and its implications for leptonic charge values are investigated. (auth)

18511 HADRONIC SYMMETRIES AND GAUGE THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTION. Nikolaev, N. N. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 350-353(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 492-495(20 Oct 1972).

A renormalizable theory of weak and electromagnetic interactions with spontaneously violated SU(2) × U(1) gauge symmetry including the usual SU(3) quarks with fractional charge and allowing preservation of the observed hadronic symmetries is described. (JFP)

Applications (Strong)

Refer also to abstract 18335.

18512 (LBL-1366) SU(3) CLASSIFICATION OF BARYON RESONANCES. Barbaro-Galtieri, A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Oct 1972. Contract W-7405-eng-48. 23p. (CONF-720954-13). Dep. NTIS.

A review is given of data on the baryon resonance classification. The individual multiplets for which the amount of data available is sufficient to perform constrained fits and other possible multiplets are discussed. Large discrepancies for unbroken SU(3) fits to the couplings which seem to persist in the $^3/_2^+$ decuplet and the $^3/_2^-$ octet and singlet states are noted. (JFP)

18513 CONSTRUCTION OF THE EFFECTIVE LAGRANGIAN OF PIONIC PROCESSES FOR ARBITRARY SU(2) x SU(2) BREAKING. Hasenfratz, P. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 199-205(1972).

By assuming that SU(2) × SU(2) symmetry is broken by the isoscalar element of the representation (l,l), effective Lagrangians reproducing the results of current algebra and the PCAC assumption can be constructed by a direct method suggested by R. Dashen and M. Weinstein. The symmetry-breaking parts of these Lagrangians are the solutions (in closed form) of the differential equation for the breaking parts in Weinberg's formalism. (auth)

18514 PREDICTIONS ON THE COUPLINGS OF f- AND ρ-TRAJECTORIES TO MESONS FROM CHIRAL SYMMETRY. Kleinert, H.; Ram Mohan, L. R. (Freie Univ., Berlin). Nucl. Phys., B52: No. 1, 253-279(1973).

A chiral saturation scheme involving 15, L = 0, and 15, L = 1 mesons in a classification according to SU(4) ⊗ O(3) (i.e. the mesons π, ρ, ω, A_1, A_2, f, A_0 (δ), B, D and σ) we employ and calculate all f and ρ Regge couplings between these mesons via a matrix version of finite-energy sum rules. In addition the size of exotic exchanges is evaluated and found to be small. The results are compared with experimental numbers and other models as far as available. (auth)

18515 SPONTANEOUS SU_3 BREAKING AND THE KAPPA-MESON. Bessler, L. (London Univ.). Lett. Nuovo Cim.; 6: No. 2, 73-76(13 Jan 1973).

It was previously argued that the role of the kappa meson in the (3,3*) + (3*,3) model of broken chiral SU(3) × SU(3) symmetry should be such that the limit of no explicit breaking (the limit where the symmetry-breaking part of the hadron Hamiltonian vanishes) is characterized by (1): $\langle 0|\mu_8|0\rangle \equiv \lambda_8 = 0$, $F_\kappa = 0$, $M_\kappa \neq 0$ and not by $\lambda_8 \neq 0$, $F_\kappa \neq 0$, $M_\kappa = 0$. An attempt was previously made to show that requiring alternative off-mass-shell definitions of the one soft pseudoscalar particle to one-soft-pseudoscalar-particle matrix elements of the scalar densities to coincide, (2): $\lim_{p\to 0}[\lim_{p'\to 0} M_{ijk}(p,p')] = \lim_{p'\to 0}[\lim_{p\to 0} M_{ijk}(p,p')]$ necessarily implies the relation (1). It is demonstrated that the requirement in (2) allows the limit of no explicit breaking to be realized with either $\lambda_8 = 0$ or $\lambda_8 \neq 0$. (JFK)

Field Theories

Refer also to abstract 18251.

General

18516 NEW ATTEMPT AT A UNIFIED FIELD THEORY. Ivanenko, D. (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 341-52(1972).

It is attempted to construct an improved version of the nonlinear spinor field theory originally proposed by the author and Heisenberg. A new perturbation theory dissimilar to the Tamm–Dancoff one is used for the case of degenerate vacuum. Furthermore, a new propagator is introduced and the existence of unitary symmetry is supposed to hold from the very beginning, i.e. essentially a nonlinear theory of quarks is proposed. (auth)

18517 BALANCING OF ELECTROMAGNETIC AND GRAVITATIONAL FORCES AND TORQUES BETWEEN SPINNING PARTICLES AT REST. Tiomno, J. (Inst. for Advanced Studies, Princeton, NJ). Phys. Rev., D; 7: No. 2, 356-362(15 Jan 1973).

The results reported here arise from a line of development that includes the following: (1) Schiff (1960), precession of a spinning object in a gravitational field endowed with "magnetic" components, (2) Oliveira and Tiomno (1962), same precession derived from the Dirac equation plus correspondence principle, (3) present work, determination of the force on a spinning object again by use of Dirac's equation plus the correspondence principle—in agreement with what Wald and what Wilkins and Ruffini find from Papapetrou's classical equations of motion for a spinning object. The same result also follows from Kramer's classical nonrelativistic Hamiltonian formalism applied to electromagnetic and gravitational interactions. It is demanded that any coupling of a spinning object with a "magnetic" type of gravitational field must satisfy the principle of equivalence of gravitational and inertial forces in the sense that the gravitational "gyromagnetic" factor must be exactly unity. The resulting equations of motion are used to prove that if a system of arbitrarily spinning charged particles, satisfying the conditions $q_i = m_i$ and with gyromagnetic factors $g_i = 2$, is initially at rest it will remain at rest and without precession of the spins. This gives an insight on how the solutions of the Einstein-Maxwell equations recently obtained by Perjés and by Israel and Wilson can be stationary in spite of a nonvanishing magnetic field. (auth)

18518 ELECTROMAGNETIC RADIATION FROM CHARGES IN WEAK GRAVITATIONAL FIELDS. Peters, P. C. (Univ. of Washington, Seattle). Phys. Rev., D; 7: No. 2, 368-392(15 Jan 1973).

The electromagnetic potential of a point charge in arbitrary motion in a weak gravitational field of a mass M is found by a Green's-function approach. This solution is then applied to the study of the geometrical effects on the generation and propagation of electromagnetic waves to first order in the Riemann tensor. The electromagnetic field is considered as a small perturbation in the sense that its gravitational field is negligible. Generally the received radiation is generated by the charge at two retarded times: that for the direct path of a null ray and that representing geometrical scattering off of the central mass. Explicit expressions for the power radiated are found in the small-ωr′ and large-ωr′ limits, where r′ is the distance of the charge from the central mass, for both nonrelativistic and relativistic motion. The analysis shows under what conditions one may suitably make an approximation based on ray optics or photon emission. In the small-ωr′ limit the power radiated by the charge is found to be smaller than calculated by a red-shift argument, and the total power de-

pends on the orientation of the accelerating system to the mass M. For the case of nonrelativistic free-fall acceleration of the charge, geometrical corrections to the power radiated are of order v^2/c^2 smaller than the dominant contributions calculated from flat-space electromagnetism. Although the concept of constrained uniform motion is not precisely defined in a gravitational field, any reasonable definition gives electromagnetic radiation for a uniformly moving charge of a calculable amount in a gravitational field, in contrast to the nonexistence of such radiation in empty flat space. In the extreme relativistic limit ($v \simeq c$) the radiation from a uniformly moving charge is orders of magnitude larger than that from a freely falling charge; in either case large amounts of radiation are received by the observer at a time such that the charge, at the retarded time, is far from the mass and unambiguously moving uniformly. The geometrical origin and implications of this radiation are discussed and related to the corresponding situation in gravitational radiation. (auth)

18519 SUPERLUMINOSITY, SOUND PROPAGATION, AND CAUSALITY. Drope, E. (Institut fuer Theoretische Physik, Cologne). Z. Phys.; 258: No. 2, 163-174(1973).

Different field theories may lead to identical equations of state. Depending on the field theory from which an equation of state is derived, in the superluminal density domain the sound wave propagation velocity exceeds (does not exceed) the velocity of light if the field is a medium with normal anomalous dispersion. Super-light sound violates causality, causality violations lead to logical paradoxies; thus superluminal density regions should be regions of anomalous dispersion. (2 figures) (auth)

Quantum Field Theory

Refer also to abstracts 18359, 18375, 18383, 18507, 18564, 18567, and 18570.

18520 (DESY-72/68) FIELD THEORY WITH COMPUTABLE LARGE-MOMENTA BEHAVIOR. Szmanzik, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Nov 1972. 7p. Dep. NTIS (U. S. Sales Only).

The large-momenta behavior of Feynman amplitudes of the usual ϕ^4 theory can be computed at generic momenta to arbitrary accuracy from an asymptotic expansion obtained by renormalization group techniques, provided the renormalized coupling constant g is negative. It is also shown that the imaginary part of the four-point vertex function in ϕ^4 theory should not change sign. The objections against the $g < 0$ mode of that theory to exist are discussed; in the mentioned asymptotic expansion no physical principle appears to be violated. (auth)

18521 (JINR-P2-6864) QUANTIZATION OF NONLOCAL FIELD THEORY. Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 39p. (In Russian). Dep. NTIS (U. S. Sales Only).

The scheme of quantization of nonlocal field theory is formulated. An intermediate regularization is introduced into the nonlocal Lagrangian of the classical scalar field in such a way that the procedure of the canonical quantization leads to the appearance of additional ghost states with indefinite metrics. The ghost states disappear when the regularization is removed, but the propagator of the scalar particle becomes nonlocal and the S-matrix is finite, unitary, causal, and covariant in each perturbation order. (auth)

18522 (ORO-3992-116) S-MATRIX FOR FINITE QUANTUM ELECTRODYNAMICS IN THE HEISENBERG REPRESENTATION. Chiang, C. C.; Gleeson, A. M. (Texas Univ., Austin. Center for Particle Theory). Dec 1972. 54p. (CPT-170). Dep. NTIS.

In this paper we present a covariant formulation of S-matrix in the Heisenberg representation for finite quantum electrodynamics. The theory involved the use of an indefinite metric implemented with the idea of shadow states. The indefinite metric is used to make the theory finite and the idea of shadow states is introduced in order that the S-matrix for physical scattering processes is unitary. The equations of motion for the field operators are solved with the proper choice of boundary conditions according to the idea of shadow states. A consequence of this choice of boundary conditions is demonstrated by the problem of vacuum polarization. It turns out that the analytic property of the matrix element in this formalism is quite different from that in the conventional theory. Following the methods of Källen and of Yang and Feldman, we proceed to construct the S-matrix for the physical scattering processes. The explicit forms for the S-matrix in the perturbation expansion up to second order in e are given. Some unfamiliar features of this formalism, such as the presence of acausal effect, piecewise analyticity of the scattering amplitudes, and the reinterpretation of crossing symmetry are also discussed. (auth)

18523 BETHE–SALPETER EQUATION. Keam, R. F. (Univ. of Auckland, New Zealand). pp 202-10 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

A review is given of research on the Bethe–Salpeter equation. The solutions of this equation are discussed. (JFP)

18524 SPECTRUM GENERATING CURRENT INCLUDING SPIN–ORBIT AND LAMB SHIFT FOR HYDROGEN. Baiquni, A. (Gadjah Mada Univ., Jogjakarta, Indonesia). pp 312-18 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The hydrogen atom, as the simplest composite system, is taken as a test object for the desired dynamical equation for hadrons, which might lead to the correct conserved current. (JFP)

18525 STOCHASTIC SPACES. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 75-81(1972).

The phase fluctuations of the wave propagating in a stochastic homogeneous medium, particularly in a physical vacuum, are calculated. The notion of stochastic space is introduced. It is shown that to obtain convergent results in the relativistic case it is necessary to introduce a "cut-off" factor. (auth)

18526 A COMPLETE SYSTEM OF RELATIVISTIC THREE-PARTICLE STATES. Bogoslovskii, G. Yu. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 301-307(1972). (In Russian).

By using a method previously developed by the author (1971), the group of invariant transformations of three-particle phase space and the parametrization of the relativistic energy surface were investigated. An orthonormalized basis system of states on this surface was obtained. (1 figure) (tr-auth)

18527 NONABELIAN GAUGE FIELDS WITH TWO MASSES. Tevikyan, R. V. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 2, 87-92(1972). (In Russian).

It is suggested to introduce two masses into the Lagrangian of the massive Yang–Mills Field. (auth)

18528 FIELD THEORY WITH COMPUTABLE LARGE-MOMENTA BEHAVIOR. Symanzik, K. (DESY, Hamburg). Lett. Nuovo Cim.; 6: No. 2, 77-80(13 Jan 1973).

The ϕ^4 theory with a negative renormalized coupling constant is considered. In such a theory the large-momenta behavior of its Feynman amplitudes can be computed at generic momenta to arbitrary accuracy. Also it is found that the imaginary part of the four-point vertex function in ϕ^4 theory should not change sign in momentum space. (JFP)

18529 NONSTANDARD $\lambda{:}\phi_2^4(\chi)$: MODEL. I. The Technique of Nonstandard Analysis in Theoretical Physics. Kelemen, P. J.; (New York Univ., NY); Robinson, A. J. Math. Phys. (N.Y.); 13: No. 12, 1870–1874(Dec 1972).

The methods of nonstandard analysis are demonstrated as a preliminary step for the construction of the nonstandard $\lambda{:}\phi_2^4$: model. Elementary quantum mechanical problems are solved and the renormalization of the scalar field (Yukawa interaction) is investigated. (auth)

18530 DIVERGENT PERTURBATION EXPANSION FOR THE VACUUM POLARIZATION BY AN EXTERNAL FIELD. Graffi, S. (New York Univ., NY); Grecchi, V. J. Math. Phys. (N. Y.); 13: No. 12, 2008-2012(Dec 1972).

The divergent perturbation expansion of the exactly solvable vacuum polarization by an external constant electromagnetic field is examined. It is proven that the Stieltjes method, known to be valid for the vacuum polarization by a pure electric or a pure magnetic field, fails in the general case to sum the perturbation expansion to the exact solution. This implies the nonconvergence of the Padé approximants to the solution under the conditions. The validity of the Borel summation method and the convergence of the related approximation procedures are also proven. (auth)

18531 NONSTANDARD $\lambda{:}\phi_2^4(\chi)$: MODEL. II. The Standard Model From a Nonstandard Point of View. Kelemen, P. J. (New York Univ., NY); Robinson, A. J. Math. Phys. (N.Y.); 13: No. 12, 1875-1878(Dec 1972).

As a second step in the construction of the nonstandard $\lambda{:}\phi_2^4$: model we analyze Glimm and Jaffe's work from the nonstandard point of view. (auth)

18532 ELECTRODYNAMICS OF SPIN-0 MESONS AT SMALL DISTANCES. Fry, M. P. (Naval Ordnance Lab., Silver Spring, MD). Phys. Rev., D; 7: No. 2, 423-449(15 Jan 1973).

It is shown that if Z_3 (where Z_3 is the photon wave-function

renormalization constant) is assumed finite and the nonasymptotic part h of the renormalized photon propagator vanishes with power-law behavior, then all the remaining renormalization constants in scalar electrodynamics can be made finite order by order, except the charged-meson self-mass δm^2. The condition that δm^2 be finite forces the asymptotic coupling α_0 to satisfy at least one eigenvalue equation. A second eigenvalue condition for α_0 emerges from the requirement that the theory have a Hermitian Lagrangian. Finally, on the basis of the renormalization group, it is expected that the initial assumption of a finite value of Z_3 is self-consistent only if α_0 satisfies a third eigenvalue condition. Hence, it is conjectured that a completely finite, closed theory of scalar electrodynamics is probably internally inconsistent. Assuming that h falls off sufficiently rapidly, it is shown that the meson propagator has a very simple asymptotic form for momenta much greater than its physical mass. (auth)

18533 ξ-LIMITING PROCESS IN SPONTANEOUSLY BROKEN GAUGE THEORIES. Fujikawa, K. (Univ. of Chicago). Phys. Rev., D; 7: No. 2, 393-398(15 Jan 1973).

It is shown that the ξ-limiting regularization process of Lee and Yang can be recognized as a nonlinear gauge condition in the general non-Abelian gauge theory. The ξ-limiting process, however, differs from the general gauge-invariant formulation of the spontaneously broken gauge theories for finite ξ. Some of the problems related to the implementation of general gauge conditions are also briefly discussed. (auth)

18534 SCALING BEHAVIOR IN A FOUR-DIMENSIONAL SOLVABLE FIELD THEORY. Hellman, W. S.; Oliver, J. (Boston Univ.). Phys. Rev., D; 7: No. 2, 399-402(15 Jan 1973).

The scaling properties of a four-dimensional scale-invariant solvable theory are examined. It is found that the scaling laws of the fields and the propagator behave quite differently from the two-dimensional situation. The fermion field scales with a noncanonical dimension while the propagator does not. (auth)

18535 QUASISTABILITY OF THE POMERANCHUKON IN A REGGEON CALCULUS MODEL. Bronzan, J. B. (Rutgers-The State Univ., Brunswick, NJ). Phys. Rev., D; 7: No. 2, 480-487(15 Jan 1973).

A ladderlike sum of diagrams is studied in Gribov's Reggeon calculus. This model possesses the dynamical mechanism that can produce quasistability, and it is found that most of the features of Gribov and Migdal's quasistable Pomeranchukon are realized in the model. A major new feature is the presence of an infinite number of new vacuum poles that accumulate at j = 1. (auth)

18536 LINEAR RELATIONS AMONG NORMAL-PRODUCT FIELDS. Gomes, M.; (Univ. of Pittsburgh); Lowenstein, J. H. Phys. Rev., D; 7: No. 2, 550-554(15 Jan 1973).

General equations of motion are derived for normal-product fields within Zimmermann's formulation of renormalized perturbation theory. The equations of motion and Zimmermann identities relating normal products of different degree are shown to exhaust the linear relations among composite fields. An enlarged class of Ward-identity anomalies is discussed briefly, with specific reference to the breakdown of strict partial conservation of axial-vector current in a nonlinear σ model. (auth)

18537 HYDROGENIC-CARBON LAMB SHIFT STUDIED VIA MOTIONAL ELECTRIC FIELD QUENCHING OF THE $2^2S_{\frac{1}{2}}$ STATE. Kugel, H. W. (Rutgers—The State Univ., New Brunswick, N. J.); Leventhal, M.; Murnick, D. E. Phys. Rev., A; 6: No. 4, 1306-21 (Oct 1972).

Beams of bare carbon nuclei were produced at 25 and 35 MeV using the Bell—Rutgers tandem Van de Graaff accelerator. Hydrogenic atoms, C^{5+}, were formed by electron pickup in dilute argon gas. About 2.2% of the C^{5+} beam is found to be in the metastable $2\ ^2S_{\frac{1}{2}}$ state. On entering a magnetic field, the metastables are Stark quenched by the motional electric field $(\gamma/c)\ \vec{v} \times \vec{B}$. The quench-radiation decay length was determined by counting C^{5+} Lyman-α quanta as a function of distance traversed in the field. Windowless electron multipliers and thin-window gas-flow proportional counters were used to detect the 33.8-Å radiation. The decay length, as a function of field and energy was used to determine the Lamb shift ($2\ ^2S_{\frac{1}{2}} - 2\ ^2P_{\frac{1}{2}}$ splitting) with the aid of Bethe—Lamb quenching theory. The result is 780.1 ± 8.0 GHz. Corrections due to beam deflection, background, $2\ ^2P_{\frac{1}{2}}$ state mixing, special relativity, and Zeeman effect are considered. Recent calculations are in agreement with the experimental result. (auth)

18538 QUANTUM THEORY OF ELECTROMAGNETIC FIELDS INTERACTING WITH ATOMS AND MOLECULES. Stenholm, S. (Univ. of Helsinki). Phys. Rep.; 6C: No. 1, 1-121(Jan 1973).

This paper reviews the recent achievements in nonrelativistic quantum electrodynamics, especially nonlinear and coherent phenomena. The general properties of coupled radiation and matter are presented within simple models. The following sections treat in some detail three main aspects of the system and can be read independently of each other. Some experiments with long-wave length radiation (rf) and atoms, the quantum theory of a laser and the ensuing photon distributions, the case of strongly correlated emission of radiation called superradiance are treated. The use of statistical ensembles is briefly discussed, and some technical details of the text are presented. (auth)

18539 GAUGE INVARIANT QUANTUM ELECTRODYNAMICS WITH THE MASS-CHANGING MINIMAL CURRENT. Namiki, M.; Yokoyama, K. (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2093-2105(Dec 1972).

A gauge invariant local electrodynamics with the mass-changing minimal current giving rise to excitation processes of baryon or lepton is exactly formulated by means of introducing two ghost gauge fields. It is shown that the whole S-matrix in this formalism is equivalent to that in the conventional formalism with the Feynman gauge and without the ghost fields. On the bases of these arguments, a possible form of phenomenological mass-changing current vertex function of the nucleon is suggested. (auth)

18540 FIELDS NONLOCAL IN CLIFFORD SPACE. II. QUANTUM THEORY OF INTERACTING FIELDS. Danos, M.; (National Bureau of Standards, Washington, DC); Greiner, W.; Rafelski, J. Z. Phys.; 258: No. 2, 147-162(1973).

A previously proposed field theory is quantized. The theory contains a parameter having the character of an elementary length. The value of this parameter is fixed by scaling it to the weak interaction strength. It is shown that in this way negative metric states are confined to a region of the order 10^{-15} cm. The resulting quantum theory of interacting fields is Lorentz and gauge invariant, has a unitary S matrix, and is convergent. (1 table) (auth)

18541 REMARKS ON THE POSITION OPERATOR FOR RELATIVISTIC ELEMENTARY SYSTEMS. Schroeder, U. E. (Univ., Frankfurt am Main). Acta Phys., Austr.; 35: No. 4, 389-395(1972).

The position operator for relativistic elementary systems is obtained by using the Fourier transformation that leads to a Schrödinger-like relativistic wave function in coordinate space. This procedure permits a unique determination of the Newton-Wigner position operator. The physical meaning of the position operator and the localized states is illustrated by a discussion of its expectation values and of the behavior of the states under a special Lorentz transformation. (auth)

Gravitation and General Relativity

Refer also to abstracts 18168, 18460, and 19047.

18542 MACH'S PRINCIPLE IN THE LIGHT OF MODERN COSMOLOGY. Prokhovnik, S. J. (Univ. of New South Wales, Kensington, Australia). pp 320-9 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

Some conclusions from a model of a uniformly expanding universe based on certain assumptions are considered for the Mach principle. (JFP)

18543 GENERAL RELATIVITY AND MACH'S PRINCIPLE. Waylen, P. C. (Univ. of Canterbury, Christchurch, New Zealand). pp 330-6 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

A review is given of the reformulation of gravitational theory in terms of a generally covariant integral form of the Einstein field equations. This work bears upon the fundamental significance of the value of Newton's constant. The relation between the integral theory of gravitation and the Mach principle of inertia is considered. (JFP)

18544 GENERAL-RELATIVISTIC INTERIOR METRIC FOR A STATIC CHARGED FLUID BALL WITH PRESSURE. Omote, M. (Tokyo Univ. of Education). Lett. Nuovo Cim.; 6: No. 2, 49-52 (13 Jan 1973).

An interior solution for a charged perfect-fluid ball with nonzero pressure is obtained, and it is shown that it applies to systems with large e/m (e.g. an electron for which $e/m \sim 10^{21}$). (JFP)

18545 SU(1,1) SPIN COEFFICIENTS. Perjes, Z. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 207-20(1972).

A comparative discussion of SU(2) and SU(1,1) spinor algebras is presented. Spin coefficients are introduced in both formalisms.

Although particular flat-space spin and coordinate frame is used, the fundamental relations are given in a covariant notation such that the method can easily be adapted to spinor fields in curved three-spaces also. The SU(1,1) spin coefficients are used to obtain the stationary axisymmetric gravitational equations in a form in which all the field quantities appear as spin coefficients of a flat hyperbolic three-space. (auth)

18546 RELATIVISTIC GENERALIZATION OF THE OORT–SCHWARZSCHILD FORMULA. Podosenov, P. B. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 324-327(1972). (In Russian).

A covariant statistical continuity equation was considered for the case of metrics of a uniformly rotating frame of reference. The solution obtained for this equation for $c \to \infty$ or $r \to 0$ passed over into a classical ellipsoidal Oort–Schwarzschild distribution. (tr-auth)

18547 EQUATIONS OF MOTION FOR THE SOURCES OF ASYMPTOTICALLY FLAT SPACES. Lind, R. W. (Syracuse Univ., NY); Messmer, J.; Newman, E. T. J. Math. Phys. (N.Y.); 13: No. 12, 1884-1891(Dec 1972).

We present an exact calculation that leads to the equations of motion (which naturally contain gravitational radiation reaction terms) of a system subject to no external forces. The novelty of our approach lies in the fact that the system is to be considered as the source of an asymptotically flat space and that all the relevant physical quantities such as the velocity v^μ, 4-momentum p^μ, angular momentum-center of mass tensor $S^{\mu\nu}$ (as well as higher moments) are then defined in terms of surface integrals taken at infinity. A subset of the Einstein equations (equivalent to Bondi's supplementary conditions) then yields the time-evolution equations for these variables. (auth)

18548 ELASTIC GENERAL RELATIVISTIC SYSTEMS. Glass, E. N. (Univ. of Cincinnati); Winicourt, J. J. Math. Phys. (N.Y.); 13: No. 12, 1934-1940(Dec 1972).

A theory of elastic deformations of general relativistic systems is presented. The theory is derived from a generalized Hooke's law. An important feature of this theory is that its classical limit corresponds to the classical elasticity theory of prestressed materials. A perturbation description of small deformations is developed and applied to the test body case. For the first time, the strain-curvature equation for an elastic test body interacting with a gravitational wave has been derived from a complete theory. The semi-classical work of Dyson, showing the interaction of a gravitational wave with the inhomogeneities of the shear modulus, is rederived and placed within the framework of general relativity. The theory presented is quite comprehensive in scope and applicable to fully relativistic situations such as the elastic behavior of neutron stars. (auth)

18549 GRAVITATIONAL WAVES IN THE GENERAL THEORY OF RELATIVITY. IV. Dozmorov, I. M. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 15-20(1972). (In Russian).

A generalization of the invariant criterion of a pure gravitational radiation is introduced in a tetrad formulation of the general theory of relativity. Its connection with the algebraic classification of Petrov and with various known criteria was established, as based on this classification. (tr-auth)

18550 INTERACTION OF FERMION AND GRAVITATIONAL FIELDS. Vishnyakova, S. M. (Moscow Higher Technical School). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 21-26(1972). (In Russian).

One of the problems which arise in a description of a fermion-gravitational field interaction is examined, and some possibilities of its solution are suggested. This problem is associated with transformation properties of the wave function of a particle with a one-half spin. (tr-auth)

18551 HARMONIC FRAMES OF REFERENCE IN EINSTEIN'S THEORY OF GRAVITATION. Shteingrad, Z. A. (Astronomical Inst., Moscow). Dokl. Akad. Nauk SSSR; 204: No. 4, 831-3(1 Jun 1972). (In Russian).

A frame of reference is designated "harmonic" if among the coordinate systems belonging to it only one is harmonic. Einstein's gravitational equation was treated with the method of chrometric invariants (A. L. Zel'manov, 1959) in order to ascertain certain harmonic frames of reference. (KSW)

18552 GRAVITATION THEORY: EMPIRICAL STATUS FROM SOLAR SYSTEM EXPERIMENTS. Nordtvedt, K. L. Jr. (Montana State Univ., Bozeman). Science; 178: No. 4066, 1157-64(15 Dec 1972).

I have reviewed the historical and contemporary experiments that guide us in choosing a post-Newtonian, relativistic gravitational theory. The foundation experiments essentially constrain gravitation theory to be a metric theory in which matter couples solely to one gravitational field, the metric field, although other cosmological gravitational fields may exist. The metric field for any metric theory can be specified (for the solar system, for our present purposes) by a series of potential terms with several parameters. A variety of experiments specify (or put limits on) the numerical values of the seven parameters in the post-Newtonian metric field, and other such experiments have been planned. The empirical results, to date, yield values of the parameters that are consistent with the predictions of Einstein's general relativity. (auth)

18553 DETECTION OF GRAVITATIONAL RADIATION BY ITS INTERACTION WITH ELECTROMAGNETIC FIELDS. Halpern, L. (Univ., Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 58: No. 5, 647-668(1972).

Various experiments on the detection of gravitational waves by their interaction with an electromagnetic field are discussed and classified. The results of the treatment of the phenomena by classical and quantum theory are compared. Three types of experiments are distinguished: experiments in which the electromagnetic field interacts with an elastic body and with a gravitational field; experiments on the interaction of and electromagnetic field with the gravitational field in the neighborhood of a source without the presence of an elastic body; experiments determining the frequency variations resulting from the interaction of the two fields near a source. The phenomena are treated at first by the usual exact approximation for light waves in a gravitational field, then exterior field propagation according to the Maxwell theory is introduced in the linear approximation, and finally it is shown how the situation is changed if the exchange of energy between the fields takes place by quanta. The difference is shown principally by the gravitational radiation of continuous electromagnetic wave trains in the neighborhood of a source. The treatment is adapted as well as possible to the classical theory and only a minimum of understanding of the quantum theory of a gravitational field is required. (tr-auth)

18554 NONEXISTENCE OF A RELATIVISTIC EFFECT PROPOSED BY KEITH. Reinhardt, M.; Rosenblum, A. (Univ., Bonn). Lett. Nuovo Cim.; 6: No. 5, 189-191(3 Feb 1973).

Theoretical and observational objections are made to the existence of a relativistic effect proposed by Keith. It is concluded that the effect cannot be the explanation for the residual decrease of angular momentum of the rotating spheres observed in Fremerey's experiment. (LBS)

18555 POSTULATIONAL DERIVATION OF THE NEW THEORY OF GRAVITATION. Yilmaz, H. (Perception Tech. Corp., Winchester, MA). Lett. Nuovo Cim.; 6: No. 5, 181-184 (3 Feb 1973).

It is shown that the new theory of gravitation proposed by Yilmaz is derivable from three basic postulates: (a) general covariance, (b) principle of equivalence, and (c) local constancy of the signal velocity (field with vanishing rest mass). (LBS)

18556 NOTE ON KERR–SCHILD TYPE VACUUM GRAVITATIONAL FIELDS. Urbantke, H. K. (Univ., Vienna). Acta Phys. Austr.; No. 4, 396-397(1972).

The metrics of Kerr–Schild type are identified among all radiation fields with nonexpanding rays as the plane fronted waves (with both vanishing or nonvanishing rotation of rays). (auth)

Scattering Theory

Refer also to abstracts 18791 and 19052.

18557 (JINR-P4-6834) EFFECTIVE CONSIDERATION OF THE VIRTUAL STATES OF THE CONTINUOUS SPECTRUM. Zhigunov, V. P.; Zakhar'ev, B. N.; Niyazgulov, S. A.; Fenin, Yu. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

A method is suggested allowing the inelastic scattering processes to be described. The wave function is constructed by using the purely discrete set of basis functions of the internal motion of colliding particles. (auth)

18558 STATE VECTORS WITH VANISHING NORM AND THE PROBABILITY INTERPRETATION. Nagy, K. L. (Roland Eoetvoes Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1–4, 127-33(1972).

After an analysis of why theories with dipole states do not give a unitary physical S-matrix automatically, a reasonable unitarization procedure is proposed working even for these pathological cases. (auth)

18559 SPECTRAL REPRESENTATION FOR COULOMB WAVEFUNCTIONS. Townsend, J.; Feldman, G.; Fulton, T.

(Johns Hopkins Univ., Baltimore). J. Math. Phys. (N.Y.); 13: No. 12, 1865-1868(Dec 1972).

We obtain a simple spectral representation for the momentum space wavefunctions of the Schroedinger equation with a Coulomb potential in the form of a contour integral. Both the bound state and the scattering solutions are evaluated as residues at the poles enclosed by this contour. (auth)

18560 RADICAL REMOVAL OF THE CONVERGENCE DIFFICULTIES. Rayski, J. (Jagellonian Univ., Krakow). Zesz. Nauk. Uniw. Jagiellon., No. 231, Pr. Fiz.; No. 8, 7-10(1970).

In order to avoid the pathological convergence difficulties locality is abandoned, and form factors smearing out the interaction are introduced. A method for computing the scattering amplitudes is given. (JFP)

18561 KINEMATICAL INTERPRETATION OF ANOMALOUS THRESHOLDS. Liu, Y. C. (Univ. of Nijmegen, Netherlands). Phys. Rev. Lett.; 30: No. 5, 184-188(29 Jan 1973).

It is observed that for a normal threshold $|\vec{q}|^2 = q_x^2 + q_y^2 + q_z^2 = 0$, for a triangular anomalous threshold $q_\perp^2 = q_x^2 + q_y^2 = 0$, and for a box anomalous threshold $q_y^2 = 0$, when scattering is taking place in the xz plane, with incident (or outgoing) particles moving along the z axis. (auth)

18562 COMMENT ON POSITIVE REGGE-CUT DISCONTINUITIES. Koplik, J. (Univ. of California, Berkeley). Phys. Rev., D; 7: No. 2, 558-560(15 Jan 1973).

Abarbanel has recently derived a formula for the discontinuity across the two-Reggeon branch point using direct-channel unitarity. His derivation assumes that a "two-Reggeon irreducible" kernel does not contain J-plane singularities in the vicinity of the branch point. This assumption is investigated for the two-Pomeranchon cut using an extension of the multi-Regge arguments of Finkelstein and Kajantie. The assumption for $\alpha_P(0) = 1$ is verified, but the result is inconclusive otherwise. (auth)

18563 SPECTRUM-GENERATING ALGEBRA AND NO-GHOST THEOREM FOR THE NEVEU-SCHWARZ MODEL. Brower, R. C.; Friedman, K. A. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 7: No. 2, 535-539(15 Jan 1973).

The no-ghost theorem of Brower for the conventional dual model (intercept $\alpha_0 = 1$) is extended to the Neveu-Schwarz model, and its spectrum-generating algebra is constructed. These conformally invariant generators (A_n, B_s) are obtained by a systematic use of the gauges G_r. As a consequence it is demonstrated that particular dual models having resonances with positive-definite norms and masses are possible. (auth)

18564 SPACE-TIME ANALYSIS OF HIGH-ENERGY SCATTERING. Orzalesi, C. A. (New York Univ., NY). Phys. Rev., D; 7: No. 2, 488-509(15 Jan 1973).

A phenomenological space-time analysis of high-energy scattering is presented. For a two-body process $a + b \to c + d$, the off-shell amplitude $A(\nu, \kappa, \kappa', t)[\nu \equiv (p_a + p_c)\cdot p,\ p \equiv p_b + p_d,\ \kappa = (p_a + p_c)^2,\ t = \Delta^2 = (p_c - p_a)^2,\ \kappa' = (p_a + p_c)\cdot\Delta = p_c^2 - p_a^2 \equiv \kappa_c - \kappa_a]$ is written in terms of its Lehmann-Symanzik-Zimmermann correlation function $F(z\cdot p, z\cdot\Delta, z^2, t)$. The properties of $A(\nu, \kappa, \ldots)$ in the R-limit ($\nu \to \infty$, with κ, κ', and t fixed) and in the A-limit ($\nu \to \infty$, $\omega \equiv -\kappa/2\nu$, κ', and t fixed) are translated into space-time properties of $F(z)$. By combined use of the assumed Regge $\nu^{\alpha(t)}$ R-limit behavior, scaling $\nu^{\rho-2}F(\omega)$ A-limit behavior, as well as of the assumed Regge small-ω A-limit behavior $\lim_{\omega\to 0}\lim_A A(\nu, \kappa, \ldots) = \lim_{\kappa\to\infty}\lim_R A(\nu, \kappa, \ldots)$, the form of $F(z)$ in the interesting space-time regions is determined to be $(z\cdot p)^{\alpha(t)}\, g(z\cdot\Delta, z^2, t)$ as $(z\cdot p) \to \infty$ and $f_\rho(z\cdot p, z\cdot\Delta, t)(z^2)^{-\rho}$ near the light cone (LC) $z^2 = 0$, with $f_\rho(\lambda, 0, t) \sim \lambda^{\alpha(t)}$ as $\lambda \to \infty$. This latter property of f_ρ is shown to uniquely correspond to having quark-hadron amplitudes with Regge behavior, at least in quark models for light-cone operator-product expansions. The large-z^2 behavior of $F(z)$ is determined from the assumed Regge behavior of the pole-dominance approximation to $A(\nu, \kappa, \ldots)$, and again a $(z\cdot p)^{\alpha(t)}$ large-$(z\cdot p)$ behavior of $F(z)$ in this region is found. The emerging picture is simply summarized by setting $F(z) \cong f_\rho(z\cdot p, 0, t)g(z\cdot\Delta, z^2, t)$ with $g(z\cdot\Delta, z^2, t) \sim (z^2)^{-\rho}$ near the LC. The only important space-time regions for high-energy scattering are the regions $z\cdot p \sim O(\nu)$, which is shown to determine the moving Regge poles, and $z^2 \cong 0$, which is shown to give rise to a fixed-pole behavior if and only if $\alpha(t) < \rho - 2$. The high-energy limit of semiweak exclusive processes is also considered and it is shown that, contrary to existing claims, such processes need not scale. (auth)

18565 CONSEQUENCES OF T-CHANNEL UNITARIZATION IN THE STRONG REGGE-CUT MODEL. Mukherji, N.; Desai, B. R. (Univ. of California, Riverside). Phys. Rev., D; 7: No. 2, 470-479(15 Jan 1973).

Using the K-matrix method the amplitude predicted by the strong Regge-cut model is made consistent with t-channel unitarity. The resulting amplitude is found to have complex-conjugate Regge poles, $\alpha_R \pm i\alpha_I$, for $t \leq 0$ on the physical sheet of the j plane. Its j-plane discontinuity has a sharp peak at $j = \alpha_R$. The contribution of the discontinuity near the tip of the cut, $j = \alpha_c$, as well as the problem of approximating the entire discontinuity integral by complex poles, are discussed. (auth)

18566 STRONG ABSORPTION COMPATIBLE WITH UNITARITY. Hama, M. (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2112-2114(Dec 1972).

A new form of the strong absorptive correction to simple Regge pole amplitudes for the imaginary part of the scattering amplitudes is presented. This is compatible with unitarity. Absorptive corrections for production amplitudes are assumed, and the non-iterative form of the unitarity equations is used. (JFP)

18567 BETHE—SALPETER AMPLITUDES OBTAINED BY MEANS OF THE STEREOGRAPHIC PROJECTION IN THE WICK—CUTKOSKY MODEL. Nakanishi, N. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2066-2076(Dec 1972).

In the equal-mass or unequal-mass Wick–Cutkosky model, two apparently different sets of solutions are known to be obtained by the stereographic-projection method. The equivalence between them is explicitly demonstrated by proving a remarkable integral formula for the Cutkosky function. Some instructive discussions are made on the normalization integral of the solution. (auth)

18568 FEYNMAN-LIKE RULES FOR THE DUAL-RESONANCE MODEL ON THE BASIS OF THE NAKANISHI DECOMPOSITION. Yoneya, T. (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2044-2065(Dec 1972).

We present Feynman-like rules for the dual-resonance model, whose counting rule is the same as in the conventional field theory. Our approach is based on the Nakanishi decomposition of the n-point Veneziano formula. This decomposition is extended to general loop amplitudes. One advantage of this scheme is that the periodicity problem for the loop amplitudes is automatically removed, at least at the one-loop level. (auth)

18569 DIRECT METHODS IN SCATTERING THEORY. Zakhar'ev, B. N. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 149-161 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

The most general and nearly correct approach to the description of nonrelativistic quantum-mechanical scattering processes for many-body systems is realized by methods taking into account close multichannel coupling. One of the simplest examples of multichannel scattering is the motion of a particle in a field $V(r,\theta,\phi)$ without spherical symmetry. Formulation of the three-body scattering problem is then addressed. Scattering without rearrangement of particles and reactions with rearrangement of particles are subsequently considered. The method of hyperspherical harmonics for scattering problems is then described. There follow discussions of reactions of the type $1 + (23) \to 1 + 2 + 3$, variational bounds for scattering parameters, and treatment of reactions of general type without separating asymptotic components in Ψ. In conclusion, it is pointed out that attempts to achieve better accuracy by inclusion of more terms are eventually thwarted by errors arising in numerical procedures. A trivial way of improving results by using a combination of different methods is described. (RWR)

18570 DUAL AMPLITUDES CONSTRUCTED ON $J > 0$ INTEGER POINT $SU_{1,1}$ REPRESENTATIONS. Lebrun, J. P. (CERN, Geneva). Nuovo Cim.; 13A: No. 2, 499-513(21 Jan 1973).

One studies the possibility of constructing factorizable dual amplitudes based on positive integer point $SU_{1,1}$ representations. The $(2J + 1)$ invariant subspace in $D^{(x)}$ leads in this case to a $(2J + 1)$-dimensional generalized zero mode that can be interpreted in terms of an internal spin of the ground state. Typically, Born-term amplitudes constructed in this manner will exhibit multipole ghosts on nonleading levels. A divergence is also present at the Born-term level. It is suggested that these models can also be formulated as Lagrangian field theories on a two-dimensional manifold. This may yield a way of formulating auxiliary conditions and investigating whether the state vector space can be divided in physical and nonphysical sectors. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

18571 (COO–1574–30) He II FILM TRANSFER RATES INTO AND OUT OF SOLID Ar BEAKERS. Milbrodt, T. O.; Pollack, G. L. (Michigan State Univ., East Lansing. Dept. of Physics). 1972. 12p. (CONF-720833–27). Dep. NTIS.

From thirteenth international conference on low temperature physics; Boulder, CO (20 Aug 1972).

Helium II film flow over a surface whose interaction with the helium is understood is studied. Beaker filling and emptying experiments were conducted in which the beakers are made of solid Ar. There is a van der Waals attractive potential between the Ar and He atoms, the magnitude of which may be calculated from experimentally derived He–He and Ar–Ar potentials. This potential in turn determines the thickness of the He film on the beaker walls. Making the Ar beakers and other details of the experiment are described at length. It was found that the observed film height dependence and observed dependence on driving force were generally in good agreement with theory. The flow rates were 20 to 30% lower than expected from theory. (MHR)

18572 (MATSCIENCE-73) LECTURES ON THE THEORY OF QUANTUM FLUIDS. Sridhar, R. (Institute of Mathematical Sciences, Madras (India)). 1972. 95p. Dep. NTIS (U. S. Sales Only).

The following subjects are covered: Bose statistics and liquid ^{4}He, Landau's theory, rigorous attempts to quantize fluid flow, and recent developments. (MHR)

18573 MICROSCOPIC CALCULATIONS FOR LIQUID HELIUM AND ADSORBED HELIUM MONOLAYERS. Lai, H. W. Evanston, IL; Northwestern Univ. (1972). 152p. University Microfilms Order No. 72-32,486.

Thesis.

Microscopic calculations at absolute zero were carried out. The dispersion of the phonon spectrum in liquid ^{4}He is investigated beginning with first principles. The ground state properties of liquid ^{4}He were studied by a variational procedure employing a trial wave function which incorporates three-particle correlations into the Jastrow function. A quantum theory of physically adsorbed He monolayers is developed. (M.H.R.)

18574 ABSORPTION OF FIRST SOUND IN SUPERFLUID HELIUM NEAR T equals 0. Khalatnikov, I. M.; Matveev, Yu. A. JETP Lett. (USSR) (Engl. Transl.); 16: No. 3, 123-5(5 Aug 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 3, 177-9(5 Aug 1972).

Saslow [Phys. Rev. A_5, 1491, (1972)] states that there is a discrepancy between the sound absorption coefficients calculated by solving the kinetic equations for the phonons and the results of the solution of the hydrodynamic equations. It is shown that there is an error in that paper, since Saslow used for the sound-absorption coefficient an expression obtained from the hydrodynamic equations while neglecting the thermal expansion coefficient $(\partial\rho/\partial T)_p$ of ^{4}He. It is pointed out that this is not permissible at low temperatures. (MHR)

18575 P–V ISOTHERMS OF ^{4}He AT LOW TEMPERATURE. Berry, K. H. (National Physical Lab., Teddington, Eng.). Metrologia; 8: No. 3, 125(1972).

Preliminary results are presented of more accurate pressure–volume isotherm measurements at several temperatures in the range 2 to 20°K, to reduce the systematic errors in reference temperature and second virial coefficient of ^{4}He (thermometric gas). (GF)

18576 EFFECT OF THE COUNTER FLOW OF NORMAL AND SUPERFLUID ON THE VELOCITY OF SECOND SOUND IN He II. Vidal, F. (Ecole Normale Superieure, Paris). Compt. Rend., Ser. B; 275: No. 16, 609-612(16 Oct 1972). (In French).

Measurements of the velocity and attenuation of second sound in the presence of superfluid vortices created by a supercritical counter flow demonstrate that the velocity of second sound decreased. This reduction in velocity is two orders of magnitude greater than that predicted by the Vinen theory. (France)

18577 THEORETICAL STUDY OF SURFACE OSCILLATIONS IN SUPERFLUID HELIUM. Seiden, J. (Paris Univ., Orsay, France). Compt. Rend., Ser. B; 275: No. 20, 713-716(13 Nov 1972). (In French).

A theoretical study of surface excitations in superfluid helium was undertaken. Particular attention was given to the formulation of correct boundary conditions. The presence of vapor above the liquid, and the liquid compressibility were not taken into account. (auth)

18578 NEUTRON SCATTERING BY ROTONS IN LIQUID HELIUM. Huang, C. H. Stony Brook, NY; State Univ. of New York (1972). 150p. University Microfilms Order No. 73 1133.

Thesis (Ph. D.).

The energy-momentum spectrum of the elementary excitations near the roton minimum region, $1.5\ \text{Å}^{-1} < Q < 2.3\ \text{Å}^{-1}$, in superfluid helium was measured for pressures between 1 atm and the solidification pressure and for temperatures from 1.26°K to above the transition temperature T_λ by inelastic neutron scattering. The measurements were performed with the slow neutron chopper and time-of-flight spectrometer at Brookhaven National Laboratory. The dispersion curves were fitted to parabolas and the appropriate Landau parameters tabulated versus temperature and pressure. The spectrum has shifted downward from 0.736 meV at 1.26°K to 0.302 meV at 2.40°K. The minimum energy Δ decreases and the minimum wave number Q_0 is pushed toward large values as the pressure increases. By accounting for the effect of the instrumental resolution it was possible to observe a line broadening at low temperatures which sets in when the slope of the dispersion curve equals the sound velocity. There are strong indications that this is due to the roton–phonon interaction proposed by Pitaevskii. The line broadening observed when the temperature approaches T_λ is well accounted for by the roton–roton interaction as calculated by Landau and Khalatnikov. The energy dependence of the roton line shapes is well approximated by the Lorentzian form suggested by Cohen. The results have been related through thermodynamics to other properties of the liquid. (Diss. Abstr. Int., B)

18579 NEW GROUND-STATE WAVEFUNCTION FOR LIQUID ^{4}He. McGee, I. J.; Murphy, R. D. (Univ. of Waterloo, Ont.). J. Phys., C (London); 5: No. 24, L311-14(12 Dec 1972).

A product-of-pairs wavefunction for calculation of the ground-state properties of liquid ^{4}He is constructed by using zero-energy s-wave solutions of the two-body Schroedinger equation. Preliminary Monte Carlo calculations for the Lennard–Jones potential yield results essentially identical to the results of previous variational calculations but with considerably less computing effort. It is argued that the use of the procedure presented with more realistic potentials should yield results in better agreement with experiment. (auth)

18580 FORCES IN THE FLOW OF LIQUID HE II. II. SUPERFLUID FLOW. Van der Heijden, G., Giezen, J. J.; Kramers, H. C. (State Univ., Leiden). Physica; 61: No. 4, 566-580(15 Oct 1972).

Superfluid flow was studied in two capillaries with diameters of 2.94×10^{-2} and 0.95×10^{-2} cm, at temperatures ranging from 1.2 K to 1.5 K. The chemical-potential difference and the temperature difference over the capillary are determined as functions of the superfluid velocity v_s. From these values the pressure drop over the capillary is derived. Curiously, for turbulent superfluid flow, the pressure drop resembles the classical pressure drop caused by a turbulently flowing ordinary liquid. There appears to be a connection between the pressure drop and the mutual friction, suggesting that both may be related to the vorticity in the superfluid. (auth)

18581 HEAT TRANSFER WITH THE HELIUM II SUPERFLUID FILM. Liebenberg, D. H. (Los Alamos Scientific Lab., NM). Advan. Cryog. Eng.; 17: 316-22(1972).

Previous experiments are summarized and new data for the heat transport via a superfluid film are presented. The measurements show the growth of dissipation in the helium film flow and the finite temperature difference in the helium film that develops at high heater power levels. Values of the Kapitza resistance determined from the geometry of the copper block and the measured ΔT vs. W curves as a function of temperature are presented. (MHR)

18582 BREAKDOWN OF SUPERFLUIDITY FOR CYLINDERS IN SATURATED LIQUID HELIUM II. Haben, R. L. (North American Rockwell Corp., Downey, CA); Madsen, R. A.; Leonard, A. C.; Frederking, T. H. K. Advan. Cryog. Eng.; 17: 323-31(1972).

An attempt is made to account theoretically for the liquid impedance which opposes entropy transport near a single dissipative horizontal cylinder in a large pool of He II. The pertinent thermohydrodynamic conditions and similarity rules are considered. This theory includes special power law ap-

proximations. The experimental data are compared with the power laws. The data agree satisfactorily with the theory within the data scatter encountered during the experiments. (MHR)

18583 NUCLEATE BOILING OF HELIUM I IN CHANNELS SIMULATING THE COOLING CHANNELS OF LARGE SUPERCONDUCTING MAGNETS. Johannes, C.; Mollard, J. (Centre d'Etudes Cryogeniques, Sassenage, France). Advan. Cryog. Eng.; 17: 332-41(1972).

The nucleate boiling characteristics of helium I in rectangular channels were studied in detail. The helium flow circulating by thermosiphon action through the channels was measured. It was concluded that the boiling characteristics of helium in confined channels are similar to those in pool boiling on vertical surfaces but quite different from those in pool boiling on horizontal surfaces. (MHR)

Superconductivity

Refer also to abstracts 17870, 19009, 19021, and 19023.

18584 (BNL-17335) SUPERCONDUCTING CABLES: SOME RESEARCH PROBLEMS. Forsyth, E. B. (Brookhaven National Lab., Upton, N. Y.). 1972. 7p. (CONF-721210-1). Dep. NTIS.

The following subjects are discussed: mechanical and cryogenic engineering, cable design, and conclusions. (MHR)

18585 (BNL-17425) EFFECTS OF HEAT TREATMENTS ON THE SUPERCONDUCTING CRITICAL CURRENT DENSITIES OF MULTIFILAMENTARY Nb_3Sn WIRES. Suenaga, M.; Sampson, W. B.; Luhman, T. S. (Brookhaven National Lab., Upton, N. Y.). 1972. 21p. (CONF-721111-18). Dep. NTIS.

Composite conductors consisting of 19-Nb_3Sn filaments in a normal metal matrix were made by heat treating wire samples consisting of 19-Nb or Nb-1% Zr filaments imbedded in a Cu-10 wt % Sn matrix. The overall size of the composite was 2.5×10^{-2} cm and each filament was approximately 2.5×10^{-3} cm. The critical current density, J_c, at 4.2°K and 40 kG was measured for various heat treatments. It was found that the current density was a strong function of the thickness of the Nb_3Sn layers formed during heat treatments. This dependence of J_c on the thickness, d, can be approximately represented by the expression $J_c(d) \cong J_c(o) \exp[-nd]$, where $J_c(o)$ is the extrapolated zero thickness critical current density. $J_c(o)$ was found to be approximately 2.2×10^6 A/cm^2 at 40 kG for the Nb_3Sn formed from pure Nb and 1.2×10^6 A/cm^2 for that formed from Nb-1% Zr. The exponent n falls in the range 1.1 to 1.4 $(\mu m)^{-1}$ for pure Nb_3Sn depending on heat treatment temperature but is only 0.46 $(\mu m)^{-1}$ for the Nb_3Sn containing 1% Zr. The magnetic field dependence of J_c was also measured for fields up to 150 kG. (auth)

18586 (LNF-72/76) NONLINEAR EXTERNAL FIELD EFFECTS IN QUASI-SUPERCONDUCTING FILMS. Parisi, G. (Comitato Nazionale Per L'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 2 Oct 1972. 3p. Dep. NTIS (U. S. Sales Only).

Using an improved Hartree-Fock approximation on the Landau-Ginzburg equation the extra conductivity for quasi-superconducting thin films near the phase transition in the nonlinear region is computed. (auth)

18587 (LNF-72/77) EXPERIMENTAL CHECK OF NONLINEAR EFFECTS IN Al THIN FILMS CLOSE TO T_c. Lucano, G.; Pace, S.; Parisi, G.; Romani, G. L. (Comitato Nazionale per L'Energia Nucleare, Frascati (Italy). Laboratori Nazionali Di Frascati.). 2 Oct 1972. 4p. Dep. NTIS (U. S. Sales Only).

Using a mean field approximation of the time-dependent Ginzburg-Landau equation, a set of implicit equations which relate the electric field and the current in a thin film superconductor near T_c is derived. Experimental verification for this theoretically predicted nonlinear electric field dependence of the extra-conductivity in Al thin films very close to T_c is presented. (MHR)

18588 (N-72-28766) PRELIMINARY RESULTS REGARDING DEVELOPMENT OF SUPERCONDUCTING RIBBONS OF Nb_3Sn. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Translation of report LNF-70/18. NASA-TT-F-14327. 5 May 1970. 14p. NTIS.

Preliminary results of the development of superconducting ribbons of Nb_3Sn, obtained by the diffusion of tin in the niobium, are discussed. The production, and measuring apparatus and techniques are described. Characteristics of the superconducting ribbons were determined with respect to temperature. (INIS)

18589 (N-72-30742) MAGNETIC FIELD EFFECTS ON SUPERCONDUCTIVITY IN ALKALI METAL INTERCALATES OF MoS_2. Woollam, J. A.; Flood, D. J.; Wagoner, D. E., Somoano, R.; Rembaum, A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 18 Aug 1972. 10p. (NASA-TM-X-68109). NTIS.

The effects of a magnetic field on the superconducting transition in MoS_2 intercalated with potassium and sodium were studied. It was found that the potassium intercalated MoS_2 has better properties in a magnetic field. In zero magnetic field the transition to superconductivity begins near 6.4 K. Diagrams of the basic circuitry for superconducting transition studies, and charts showing critical magnetic field versus critical temperature for the intercalated MoS_2 are included. (STAR)

18590 IS THE ORDER EFFECT IN THE V_3Au SUPERCONDUCTOR ELECTRONIC OR PHONONIC? Junod, A.; Bellon, P.; Fluekiger, R.; Heiniger, F.; Muller, J. (Univ., Geneva). Phys. Kondens. Mater.; 15: No. 2, 133-141(1972). (In French).

Specific heat measurements from 1 to 40°K give some insight into the phonon spectrum of the alloy V_3Au. The minute differences between the as-cast and annealed states indicate that the drastic change of the superconducting transition temperature upon ordering is not likely to be of phononic origin. Alternatively, this behavior can be understood as a consequence of an electronic density-of-states change in the presence of a large Coulomb pseudopotential term. This assumption is supported by susceptibility measurements. (auth)

18591 SUPERCONDUCTIVITY: NEW ROLES FOR AN OLD DISCOVERY. Van Duzer, T. (Univ. of California, Berkeley); Turner, C. W. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 9: No. 12, 53-63(Dec 1972).

The current state of the art of superconductivity is discussed and a brief tutorial discussion of the theory of superconductivity is presented, including a microscopic understanding of the superconducting state. A two-fluid picture is first used to analyze situations such as transmission lines and cavities in which the low loss of superconductors is the important factor. The magnetic properties of superconductors are then introduced together with the relevant applications, including magnets and rotating machines. Finally, the Josephson effects are presented and their uses in a variety of computational, instrumentation, and communications applications. (MHR)

18592 HYBRID SUPERCONDUCTING MATERIAL. Shattes, W. J.; Marancik, W. G. (to Air Reduction Co., Inc.). U. S. Patent 3,710,000. 9 Jan 1973. Filed date 13 May 1970. 6p.

A hybrid superconducting material in which superconducting strands, at least partially surrounded by a layer of low resistance normally conducting material, are embedded in a matrix of high resistance normally conducting material. In a specific embodiment, the superconducting strands consist essentially of niobium titanium, individually surrounded by a thin sleeve of copper, and embedded in a matrix of cupro-nickel. The composite is extruded at elevated temperatures and pressure. The wire so formed may be used for electromagnet coils designed to function in a cryogenic system. (auth)

18593 SINGULARITY OF THE BEHAVIOR OF A SUPERCONDUCTING FILM IN AN ALTERNATING FIELD OF FREQUENCY CLOSE TO THRESHOLD. Ivlev, B. I. JETP Lett. (USSR) (Engl. Transl.); 16: No. 10, 401-404(20 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 10, 567-570.

The behavior of a superconducting film in an external microwave field whose amplitude in a real experimental situation is small compared with the critical value is considered. Nonlinear effects are of primary interest. (MHR)

18594 OBSERVATION OF SMALL NONLINEARITIES IN SUPERCONDUCTING TRANSITIONS OF THIN FILMS. Pankratov, N. A.; Zaitsev, G. A.; Khrebtov, I. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No 3, 926-928(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 256-258(1972).

The procedure and equipment is described for the observation of small nonlinearities in superconducting transitions of thin films, which is based on measurement of the response of the films to a periodic temperature signal. The equipment allows observation of nonlinearities of the superconducting transitions which are manifested for a temperature change by 10^{-5}°K. (auth)

18595 SUPERCONDUCTING TERNARY SULFIDE Ag_2Pd_3S. Khan, H. R. (Forschungsinstitut fuer Edelmetalle und Metallchemie, Schwaebisch-Gmuend, Ger.); Trunk, H.; Raub, Ch, J.; Fertig, W. A.; Lawson, A. C. J. Less-Common Metals; 30: 167-8(1973).

The phase relationship in the system Ag-Pd-S was determined and information on the superconductivity and other physical properties of the compounds present in this system was collected. Evidence for the existence of the compound Ag_2Pd_3S is presented. (MHR)

18596 TUNNELING OBSERVATION OF BOUND STATES IN A NORMAL METAL–SUPERCONDUCTOR SANDWICH. Rowell, J. M. (Bell Telephone Labs., Murray Hill, NJ). Phys. Rev. Lett.; 30: No. 5, 167-170(29 Jan 1973).

Bound states in the pair potential well produced in a normal metal by contact with a superconductor were observed by tunneling in Pb/Zn-zinc oxide-Pb junctions. (auth)

18597 STABILIZATION OF A SUPERCONDUCTING MODIFICATION OF BERYLLIUM BY ADDITIONS OF ALUMINUM. Lazarev, B. G.; Semenenko, E. E.; Tutov, V. I. (Physical-Technical Inst., Kharkov). Dokl. Akad. Nauk SSSR; 204: No. 4, 837-9(1 Jun 1972). (In Russian).

The superconducting property of a Be condensed on a liquid-He-cooled surface is lost by warming the Be up to about 40°K because of its instability. However, if Al is admixed with the Be, superconductivity may be "retained" on warming to room temperature for three days, although the temperature interval of superconductivity was altered from 10.5 to 8.5°K to 8 to 5°K. (KSW)

18598 INFLUENCE OF THE PINNING FORCES FOR FLUX LINES ON THE CRITICAL CURRENT DENSITY IN MAGNETIC FIELDS OF UP TO 10 TESLA IN SUPERCONDUCTING TITANIUM–NIOBIUM ALLOYS. Heller, Wolfram; Loehberg, Reinhold; Zwicker, Ulrich (Univ., Erlangen, Ger.). Z. Metallk.; 63: No. 11, 735-9(Nov 1972). (In German).

In order to determine the specific pinning force of different pinning sites in titanium–niobium based alloys, the influence on the critical current density J_c of vacancies, dislocation networks, and precipitates of alpha and omega phase and of intermetallic compounds was measured as a function of the external transverse magnetic field up to 10 Tesla. These $J_c(H)$ measurements on the alloys TiNb 50, TiNb 49 Cu 3 and TiNb 49 Ge 2.3 were compared with metallurgical investigations after different heat treatments, both with and without prior cold deformation. From the results it can be suggested that an agglomeration of vacancies produced by heat treatment in the beta region, which probably leads simultaneously to a short-range segregation, allows the critical current density at 10 Tesla to rise to 6×10^2 A/cm^2, as compared to 1×10^2 A/cm^2 for a statistical distribution of vacancies. Due to dislocation networks and precipitation of the intermetallic phases Ti_2Cu or Ti_5Ge_3, the critical current density at 10 Tesla can increase to more than 10^3 A/cm^2. The flux pinning force of the omega and alpha phase is increased by additions of copper or germanium. After 97% cold deformation and after a subsequent ageing at 400°C, the critical current density at 10 Tesla can be raised to 1.3×10^4 A/cm^2, about three times the value of the binary alloy TiNb 50. (auth)

18599 MAGNETOCALORIC BEHAVIOR OF NIOBIUM. Burgemeister, E. A.; Dokoupil, Z. (State Univ., Leiden). Physica; 62: No. 3, 357-368(1 Dec 1972).

Under adiabatic conditions in the mixed state, a type-II superconductor is cooled upon an increase of the magnetic field: the magnetothermal effect. Heat can be supplied both to compensate the magnetothermal effect and to determine the field dependence of the specific heat at isothermal magnetization. At a discontinuous increase of the field the specific heat and the magnetothermal effect were alternately measured on an annealed high-purity niobium sample with a resistance ratio of 145. Near the transition from the superconducting to the mixed state the specific heat and the magnetothermal effect display similar anomalies, which disappear at low temperatures: near $T \approx 2.05$ K no cooling was observed. The entropy production resulting from the irreversible flux entrance into the sample, has been evaluated from the total heat supplied at isothermal magnetization. This entropy production is found to be large at the lower temperatures. (auth)

18600 CONTROLLABLE LOW-RESISTANCE SHUNT METHOD OF STUDYING THE CURRENT–VOLTAGE CURVES OF COMBINED SUPERCONDUCTORS. Sychev, V. V.; Zenkevich, V. B.; Al'tov, V. A.; Kulysov, V. A. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 88-96(1972). (In Russian).

A method is described for determining the current–voltage characteristics of composite superconductors which can be used to study both short specimens (under isothermal conditions or when there is a temperature gradient lengthwise of the specimen), and specimens in the form of solenoids with open or tight windings. The proposed experimental procedure is simple and convenient, and can be used to study the state of thermal equilibrium of composite superconductors over the entire range of operating temperatures. The method has high sensitivity and gives the current–voltage curves of combined superconductors with negative resistance. (JPRS)

18601 FABRICATION AND $J_c(H,T)$ MEASUREMENTS ON $Nb_3Al_{0.75}Ge_{0.25}$ RIBBON. Loehberg, R.; Eagar, T. W.; Puffer, I. M.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Lett.; 22: No. 2, 69-71(15 Jan 1973).

Ribbons of composition $Nb_3Al_{0.75}Ge_{0.25}$ were fabricated by swaging, rolling, and heat treatment. Measurements of J_c in steady transverse magnetic fields up to 150 kOe at temperatures up to 16°K show values of the order of 10^4 A/cm^2 at 13°K and 120 kOe, and 10^3 A/cm^2 at 16°K and 95 kOe. (auth)

18602 FUNCTIONAL INTEGRAL METHODS IN STUDY OF CRITICAL FLUCTUATIONS IN SUPERCONDUCTORS. Hassing, R. F. (Ithaca, NY; Cornell Univ. (1972)). 169p. University Microfilms Order No. 73-346.

Thesis (Ph.D.).

Critical fluctuations in a superconductor in the absence of magnetic fields are studied by means of the functional integral method. An expression for the partition function appropriate to $T > T_{co}$ is obtained by expanding the free energy functional to fourth order in random fields. The resulting free energy functional is of the Ginzburg-Landau form in which, however, the order parameter is time dependent and the coefficient, b, of the fourth order term depends on frequency and wave vector. An examination of the frequency and wave vector dependence of b leads to an approximation in which only static terms are retained in fourth order. A self-consistent mean field approximation to the fourth order term then reduces the free energy functional to Gaussian form so that the partition function can be explicitly evaluated. The self-consistency condition, moreover, leads to a renormalized temperature shift in terms of which the nature of the transition can be ascertained. It is found that only in 3 dimensions does a sharp phase transition occur, with critical indices $\gamma = 2$, $\nu = 1$. In 2, 1, and 0 dimensions the mean square fluctuation in the order parameter is bounded for $T > 0$, and the mean value of the order parameter vanishes, indicating that the transition is completely suppressed in samples of reduced dimensionality. This behavior is reflected in the off-diagonal correlation function, which manifests ODLRO only in 3 dimensions and below the slightly shifted transition temperature T_c. In 2 and 1 dimensions the behavior of the renormalized temperature shift leads to "almost long range order," that is, a very large effective coherence length, below an imprecisely defined "transition" temperature $T_c^* < T_{co}$. In samples of finite size in 2 and 1 dimensions, T_c^* locates a "condensation" region within which the uniform fluctuation mode becomes dominant, making the sample effectively 0-dimensional below T_c^*. The specific heat in 3 dimensions is found to be finite at T_c, with critical index $\alpha = -1$. In 2, 1, and 0 dimensions the specific heat transition is shifted downward slightly and rounded relative to the BCS result. The functional integral transformation is also applied to the current-current correlation function. The mean field approximation to the fourth order term in the fluctuation free energy then leads to expressions for the conductivity in 3, 2, and 1 dimensions identical to those of Marcelja, with the exception of a factor of 2 contained in the renormalized temperature shift. It is found that the divergence of the conductivity of T_{co} in 2 and 1 dimensions is suppressed due to the interaction between fluctuations. Below T_c^*, the conductivity, although finite, becomes exceedingly large. (Diss. Abstr. Int., B)

18603 NIOBIUM THIN-FILM SUPERCONDUCTIVITY TUNNEL JUNCTIONS USING A SEMICONDUCTOR BARRIER. Keller, W. H. Madison, WI; Univ. of Wisconsin (1972). 147p. University Microfilms Order No. 72-27,333.

Thesis (Ph.D.).

Superconducting tunnel junctions were fabricated using rf sputtered niobium, rf sputtered semiconductor (germanium and indium antimonide) barrier and evaporated lead thin films. A photo resist process using rf sputter etching to define the niobium patterns was perfect. The current–voltage characteristics of the tunnel junctions were investigated and from these characteristics an effective rectangular barrier height for each junction was calculated. From data obtained on barrier height versus barrier thickness a barrier model was proposed. The barrier model incorporates a barrier height that decreases as barrier thickness increases. The barrier model for the germanium and indium antimonide barriers consists of a potential at the surface of the semiconductor, determined by the surface states present, decreasing toward the center of the barrier region to a limiting potential value determined by the bulk characteristics of the semiconductor. The deposited semiconductor films produced tunnel junctions with characteristics which were reasonably reproducible and which changed only mildly and uniformly with age. (Diss. Abstr. Int., B)

18604 IRREVERSIBLE EFFECTS AND PINNING. Cyrot, M. (Institut Max von Laue–Paul Langevin, Grenoble, France). J. Phys. (Paris); 33: No. 8, 803-10(Aug 1972).

Theoretical problems related to the pinning of vortices are reviewed. Great difficulties arise when attempting to link the elementary pinning force between an isolated vortex and a pinning center, and the measured pinning force. A pinning force which permits a theoretical study of the problem is experimentally defined. Results similar to those of Webb are obtained. (France)

18605 VARIATIONAL TREATMENT OF AN ISOLATED VORTEX TUBE IN TYPE-II SUPERCONDUCTOR. Khanra, B. C.; Raychaudhuri, A. K. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Lett.; 42A: No. 4, 305-6(18 Dec 1972).

The structure of an isolated vortex tube, representing the mixed state of type-II superconductors near the lower critical field, has been investigated variationally for arbitrary values of the Ginzburg-Landau (G-L) parameter κ. The results are in excellent agreement with other calculations. (auth)

18606 MAGNETIC PROPERTIES OF PURE TYPE-II SUPERCONDUCTORS. Mancini, F. (CNR, Naples). Phys. Lett.; 42A: No. 4, 287-8(18 Dec 1972).

It is shown that the magnetic properties of type-II superconductors can be computed from a knowledge of the boson characteristic function which can be determined from experimental data for the scattering of neutrons by a vortex lattice. In this consideration surface effects are neglected. (auth)

18607 EFFECT OF DISLOCATIONS ON THE LATTICE THERMAL CONDUCTIVITY OF SUPERCONDUCTING NIOBIUM. Anderson, A. C.; Smith, S. C. (Univ. of Illinois, Urbana). J. Phys. Chem. Solids; 34: No. 1, 111-22(Jan 1973).

Thermal conductivity measurements on single crystal Nb samples in the superconducting state have demonstrated a resonant scattering of thermal phonons at roughly 5×10^{10} Hz. The assumption of a mechanical resonance associated with the dislocation structure accounts for the present data and is consistent with other data found in the literature. The thermalization of phonons at an abraded sample surface, and the attendant failure of the $1^{-1} = \Sigma_j l_j^{-1}$ for phonon mean free paths, was also observed. (auth)

18608 HIGH PRESSURE THORIUM-RARE-EARTH CARBIDE SUPERCONDUCTORS. Krupka, M. C.; Giorgi, A. L.; Szklarz, E. G. (Los Alamos Scientific Lab., NM). J. Less-Common Metals; 30: 217-223(1973).

Thorium-rare-earth carbide superconducting solid solutions of general formula $(Th, R.E.)_2C_3$ (R.E. = Ho, Er, Lu, as well as Sc) were synthesized under conditions of high pressure and high temperature. Transition temperatures of 4.1 to 11.7°K were observed and are dependent upon the rare-earth element and the thorium/rare-earth atomic ratio. The occurrence of superconductivity in these systems is limited by the thermodynamic stability of the superconducting phase and the conversion from the superconducting state to one of paramagnetism. Light rare-earth elements such as Ce, Pr, and Nd also form superconducting solid solutions but with depressed transition temperatures. The intermediate rare-earth elements Gd, Tb, and Dy form magnetic solid solutions at the concentration levels investigated. The $(Th, R.E.)_2C_3$ solid solutions crystallize in the body-centered cubic Pu_2C_3 ($D5_c$) structure. (auth)

18609 NEWER CONCEPTS ABOUT METALLURGICAL INFLUENCES ON TYPE-II SUPERCONDUCTORS. Fahlenbrach, H. Metall; 26: No. 10, 1030-1(Oct 1972). (In German).

In Type-II superconductors, the magnetic flux occurs in thin lines with a cross section of approximately 1 micrometer. In these lines, superconductivity increases from the axis to the exterior while the magnetic flux behaves in the opposite manner. To allow the highest possible current as well as the highest possible magnetic fields, the flux lines must be contained in the crystal lattice by pinning forces. Possibilities for such containment through various metallurgical procedures are discussed. On the other hand, studies of superconductivity can yield important information about the metallurgical fine structure after various shaping procedures and heat treatment. (HBG)

18610 FLUCTUATION-ENHANCED DIAMAGNETIC SUSCEPTIBILITY BELOW T_c. Kumar, P. (Univ. of Roorkee, India). Phys. Lett. A; 42A: No. 7, 475-476(29 Jan 1973).

The effect of fluctuating Cooper pairs on the diamagnetic susceptibility of dirty superconducting thin films is investigated, for temperature $T < T_c$. The susceptibility decreases with the decrease in temperature, approaching $-\frac{1}{4}\pi$ at $T = 0°K$ and remains finite at $T = T_c$. (auth)

18611 CURRENT TRANSITIONS OF SUPERCONDUCTING WHISKERS. Fink, H. J. (Univ. of California, Davis). Phys. Lett.; 42A: No. 7, 465-467(29 Jan 1973).

In long one-dimensional superconductors, such as whiskers, new, current-carrying states above the critical current were found that are due to spatially periodic solutions of the order parameter and spatially periodic super and normal transport currents in parallel. These solutions lead to voltage steps in the dc voltage-current characteristic and are in good agreement with experiments. (auth)

18612 IRREVERSIBILITY AND MAGNETIC HYSTERESIS IN TYPE II SUPERCONDUCTORS. Inhaber, H. (Univ. of Oklahoma, Norman). Physica; 62: No. 3, 427-443(1 Dec 1972).

The models of hysteretic behavior of Type II superconductors of Campbell et al. and Silcox and Rollins are examined quantitatively against experimental data and qualitatively against Abrikosov's theories. A new theory of hysteretic behavior is proposed which brings good agreement with these two standards. The theory is based on taking into account fluxoid-fluxoid interactions from interfluxoid distances greater than those of nearest neighbors, and a new reversible curve. (auth)

18613 SINGULARITIES OF THE SUPERCONDUCTING TRANSITION IN PURE SINGLE-CRYSTAL TIN ACCORDING TO ULTRASONIC MEASUREMENT DATA. Fil. V. D.; Denisenko, V. I.; Bezuglyi, P. A.; Masalitin, E. A. (Physical-Technical Inst. of Low Temperatures, Kharkov). JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 328-330(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 462-465(20 Oct 1972).

Experiments are reported on the temperature dependence of the ultrasound absorption coefficient in single-crystal tin in a region adjacent to T_c. The absorption of longitudinal and transverse sound of frequency 51.4 MHz at all possible orientations of the sound wave vector and of the polarization coinciding with the principal crystallographic directions is given. The initial material for the samples was tin with $R(300°K)/R(4.2°K) = 25{,}000$. The magnetic field was compensated to a level 3 to 5 mOe. (MHR)

18614 INFLUENCE OF PLASTIC DEFORMATION ON THE BULK AND SURFACE PINNING OF FLUX LINES IN TYPE-2 SUPERCONDUCTORS. Zerweck, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phil. Mag.; 27: No. 1, 197-223(Jan 1973). (In German).

The field and temperature dependence of the pinning forces of flux lines in a Pb-5 at.%-In single crystal was determined by differential magnetization measurement of small hysteresis loops. The increase of the bulk pinning force by plastic tension can be explained qualitatively by the arrangement of dislocations in deformed fcc single crystals. The existing statistical theories which are strictly valid only for equipartition of isotropic pinning centers do not hold for a quantitative explanation of the results. The influence of deformation on the surface pinning force can be understood by the arrangement of slip lines. (UK)

18615 JOSEPHSON TUNNEL EFFECTS IN SUPERCONDUCTING ALLOYS WITH LOCAL STATES WITHIN THE GAP. Singh Nagi, A. D.; Lo. S. C. (Univ. of Waterloo, Ont.). Phys. Lett., A; 42A: No. 5, 387-388(1 Jan 1973).

The dependence of the dc Josephson current on the electron inverse spin-flip collision time for various values of ϵ_0 (the normalized position of a local state with a single impurity) was calculated. Substantial deviations from the Born approximation results were found. (auth)

18616 SPECULATIONS OF SUPERCONDUCTIVITY IN BIOLOGICAL AND ORGANIC SYSTEMS. Halpern, E. H.; Wolf, A. A. (Naval Ship Research and Development Center, Annapolis, MD). Advan. Cryog. Eng.; 17: 109-15(1972).

Some background concerning speculations that organic superconductors do exist is provided and some magnetic data are presented of two organic compounds, sodium cholate and sodium desoxycholate, that appear to have superconducting properties to support this contention. Here, it is believed that the exciton might be the cause for what appears to be an organic superconductor. (MHR)

Equipment and Devices

18617 (EUR-CEA-FC-661) MEASUREMENT OF THE MAGNETIZATION OF A SUPERCONDUCTING COIL. Porrot, E.; Rey, G.; Taquet, B. (Commissariat A L'Energie Atomique, Fontenay-Aux-Roses (France). Centre D'Etudes Nucleaires). Sep 1972. 49p. (In French). Dep. NTIS (U. S. Sales Only).

An apparatus for measuring the magnetization curve of a superconducting winding is described. The parameters of the experiment are the packing factor, the nature of the superconducting wire, and the intensity of the current in the sample. The effect of the magnetization on the value of B obtained with a superconducting coil is deduced using a computer program. (France)

18618 (LBL–851) JOSEPHSON WEAK LINKS: TWO MODELS. Hansma, P. K.; Rochlin, G. I. (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1972. Contract W-7405-eng-48. 10p. (CONF-720833–29). Dep. NTIS.

From 13th International Conference on Low Temperature Physics; Boulder, Colorado, United States of America (USA) (20 Aug 1972).

A series of experiments were performed to investigate two "models" for studying the behavior of weak-link Josephson effect structures. The first is a low-inductance, externally shunted, oxide-barrier Josephson junction. This acts as a generalized weak link in that it can be adjusted, even at liquid helium temperatures, to replicate the I–V characteristics of widely varying types of weak links. The other model is a driven, damped pendulum whose equation of motion is equivalent to the second-order nonlinear current-phase equation of the links. Observations on both models indicate the correctness of the assumed equivalent circuit by verifying the solutions in detail and provide new physical insight into the nonlinear behavior of the phase and thus of the current–voltage relationship of weak links in general. (auth)

18619 SUPERCONDUCTING MAGNET HAVING A SADDLE-SHAPED WINDING. Sychev, V. V.; Zenkevich, V. B.; Al'tov, V. A. (Inst. of High Temperatures, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 523-525(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 185-187(1972).

The construction is described and the results of tests are presented for a superconducting magnet having a saddle winding, which creates a transverse magnetic induction field of 3.0 T in a channel having a diameter of 140 mm. (auth)

18620 SUPERCONDUCTING ELECTROMAGNETIC VALVE. Kolodeev, I. D.; Kryukov, M. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 934-935(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 262-263(1972).

A superconducting electromagnetic valve is described which allows the velocity and direction of a stream of gaseous He to be varied, or to achieve separation or connection of two cavities situated in a medium having the temperature of boiling liquid He. The specific axial force developed by the valve reaches $2 \cdot 10^5$ N/m^2. (auth)

18621 CRYOSTAT FOR ACHIEVING 0.7°K BY EVACUATION OF ^{4}He BY MEANS OF A SORPTION PUMP. Voloshkevich, A. G.; Moiseenko, V. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 936(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 263(1972).

A cryostat is described for obtaining a temperature of 0.7°K, which operates on ^{4}He. The ^{4}He vapors from the working vessel are evacuated by a carbon sorption pump. The time for which the extremely low temperature is maintained amounts to >7 h for a heat influx of $3.5 \cdot 10^{-5}$W. It is possible to obtain intermediate temperatures in the 4.2 to 0.7°K interval. (auth)

18622 DOUBLE SOLENOID METHOD FOR STUDYING DYNAMIC PROCESSES IN A SUPERCONDUCTING WINDING. Sychev, V. V.; Zenkevich, V. B.; Al'tov, V. A.; Kulysov, N. A. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 81-87(1972). (In Russian).

A method is worked out for experimental investigation of processes of propagation of the normal zone in a superconducting winding. The proposed method can be used for precision determination of the principal characteristic currents in composite superconductors used in a winding. The experimental installation described completely eliminates interference from the power supply and control equipment. The procedure is relatively simple and can be recommended as a convenient tool for predicting the behavior of a composite conductor in large superconducting windings. (JPRS)

18623 THEORY OF A SUPERCONDUCTING MAGNETIC FLUX PUMP WITH A PLATE. Kazovskii, E. Ya.; Antonov, Yu. F. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 66-76(1972). (In Russian).

The electromagnetic processes were investigated in a magnetic flux pump with plate which are caused by variations in the coefficients of induction of the superconducting sections of the plate and of the system as a whole as displacement of the normal zone in the plate takes place, assuming that the magnetic flux penetrating the normal zone is constant. The physical essence of the process of current increase in the load is explained. Formulas are derived for the increments of magnetic fluxes, currents and stored electromagnetic energy in the system for "pump" and "exhaust" cycles, and the limiting current of the load is determined as a function of the magnetic flux of the electromagnet. The proposed theory can be adapted to cylinder and disc modifications of the magnetic flux pump. (JPRS)

18624 CALCULATING THE MAGNETIC FIELD OF SUPERCONDUCTING COILS OF SADDLE SHAPE WITH FERROMAGNETIC SHIELD. Borzov, G. G.; Solynshkin, N. I. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 77-80(1972). (In Russian).

An algorithm is proposed for solving the three-dimensional nonlinear problem based on the method of calculating magnetic eddy fields by means of a scalar magnetic potential in combination with expansion of current sources into their spatial harmonics. The results are presented of calculation of the induction and magnetic flux in the armature of a cryogenic machine with ferromagnetic shield; the program for calculating these parameters was compiled on the basis of the proposed algorithm. The computational data are compared with experimental results. (JPRS)

18625 USING THE EFFECT OF SUPERCONDUCTIVITY TO IMPROVE ELECTRIC POWER TRANSMITTING TECHNOLOGY. Mikhnevich, G. V.; Blinkov, E. L.; Gol'denberg, E. S. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 6-13(1972). (In Russian).

The principal characteristics and design peculiarities of superconducting electric power transmission lines are discussed. The results are given of experimental research conducted on a laboratory model of a superconducting line, as well as the results of a technical and economic comparison between lines of this type and a conventional high-voltage cable. The experimental results show the technical feasibility of a superconducting cable with total heat influx and heat release in a current-conducting system of no more than 0.1 W/m. A technical and economic analysis based on a detailed calculation of the electromagnetic, hydrodynamic and heat processes in an ac superconducting cable show that with the transmission of high powers it would be possible to reduce the cost of the cable by 2 to 3 times as compared with a conventional high-voltage cable while simultaneously reducing energy transport losses by a factor of approximately 25 times. (JPRS)

18626 CHARACTERISTICS OF ANTENNA ARRAYS OF SUPERCONDUCTING POINT-CONTACT JOSEPHSON JUNCTIONS. Repici, D. J. Washington, DC; Georgetown Univ. (1972). 135p. University Microfilms Order No. 72 34,188.

Thesis (Ph. D.).

The dc and rf characteristics of planar arrays of Josephson point contacts, as first proposed by Clark (8,9), were investigated. Such square arrays, composed of 1 mm diameter solid tin spheres arranged in a $10 \times 10 \times 1$ matrix, are shown to generate coherent rf radiation whose free space wavelengths of 1.2 mm and 101 microns have been identified. A self detection technique is employed whereby the array is placed parallel to and midway between two parallel mirrors. The dynamic conductance of the array exhibits periodic variations as a function of mirror spacing. The array is irradiated with approximately 40 nanowatts of externally generated 97 gHz (200 microvolts) microwave radiation via a 2.25 mm hole in one mirror. Photon assisted tunneling is observed and the rf response, whose structure at 1.8 mV is indicative of coherent detection, is shown to be the second derivative of the I,V characteristics. From the I,V characteristics and from the rf response of the array under external radiation, one can determine not only that the array acts as a fast coherent detector capable of resolving the incident 97 gHz radiation, but also one can estimate that between 10 and 100 nanowatts of rf power is actually radiated by the array. (Diss. Abstr. Int., B)

18627 ADVANCES IN CRYOGENIC ENGINEERING, VOLUME 17. Collection of Invited Papers and Contributed Papers Presented at National Technical Meetings During 1970 and 1971. Timmerhaus, K. D. (ed.). Cryogenic Engineering Conference Publication. New York; Plenum Publishing Corporation (1972). 508p. $30.00.

Fifty papers on recent advances in cryogenic engineering are presented. A separate abstract was prepared for each of 14 papers. Thirty-six papers are not within the scope of NSA. (LCL)

For abstracts of individual papers see: 17198, 17970, 17978, 18581–18583, 18616, and 18628–18634.

18628 APPLICATION OF COMMERCIAL MATERIALS TO THE CONSTRUCTION OF SMALL SUPERCONDUCTING MAGNETS. Williams, J. E. C. (Oxford Instrument Co., Ltd.). Advan. Cryog. Eng.; 17: 93-102(1972).

In small magnets, storing typically less than 200 k J of energy, compact high current density windings alone are competitive. This type of winding, rather than the cryostatically stable windings of very large magnets, is considered here. The following topics are covered: small superconducting magnets, magneto-thermal instability of hard superconductors, materials for small coils, niobium–titanium, and future trends. (24 references) (MHR)

18629 PERFORMANCE OF COMPOSITE COPPER–SUPERCONDUCTOR SOLDERED CONDUCTORS. Iwamoto, M.; Sato, T.; Kaneseki, N. (Mitsubishi Electric Corp.; Amagasaki, Japan). Advan. Cryog. Eng.; 17: 103-8(1972).

The concepts of quasi-stable superconducting coils and the maximum allowable disturbance that can be associated with these coils are touched on. Information is presented on some basic experiments using small pancake coils which are made of composite copper–superconductor soldered conductors (ribbon type). Voltage drop, heat dissipation, and temperature rise of the coils submerged in liquid were measured, and these experimental data are compared with theoretical predictions. (MHR)

18630 THERMOMETRIC FIXED POINTS USING SUPERCONDUCTIVITY. Schooley, J. F.; Soulen, R. J. Jr. (National Bureau of Standards, Washington, DC). Advan. Cryog. Eng.; 17: 192-8(1972).

Several factors which influence the superconductive transition and several methods of measuring the transition temperature, Tc, are reviewed. Results with superconductive Pb, In, Al, Zn, and Cd are summarized and the use of these elements in devices to provide in situ calibration of experimental thermometers from 0.5 to 7.2°K is discussed. (MHR)

18631 FORCED-FLOW, SINGLE-PHASE HELIUM COOLING SYSTEMS. Arp, V. (National Bureau of Standards, Boulder, CO). Advan. Cryog. Eng.; 17: 342-51(1972).

The advantages of using forced flow of single-phase helium for cooling of superconducting devices are pointed out. Three alternative approaches to obtain the necessary forced flow of helium are listed. The pumping losses in a low-temperature pump to circulate the helium around a closed flow loop are investigated briefly to see whether these losses are in fact significant. (MHR)

18632 STUDIES OF FORCED CONVECTION HEAT TRANSFER TO HELIUM I. Johannes, C. (Centre d'Etudes Cryogeniques, Sassenage, France). Advan. Cryog. Eng.; 17: 352-60 (1972).

Forced-convection heat transfer experiments to helium I performed in three vertical Monel tubes are described. The helium pressure ranged from 1 to 6 atm and the flow was turbulent in all cases. A critical heat flux is exhibited which is a function of mass velocity and fluid pressure. The data obtained in the supercritical region exhibit gas-like behavior at low heat flux. The heat transfer coefficient increases as the fluid and tube wall temperature approach the transposed critical temperature. (MHR)

18633 REVIEW OF FILM BOILING AT CRYOGENIC TEMPERATURES. Hsu, Y. Y. (Lewis Research Center, Cleveland). Advan. Cryog. Eng.; 17: 361-81(1972).

Present knowledge about film boiling and future work that would be productive or of interest are discussed. The discussion covers: film boiling of the unconstrained liquid mass (Leidenfrost phenomenon); pool film boiling; and forced convective film boiling inside a channel or tube. (MHR)

18634 SIMPLIFIED THEORY FOR OPTIMIZING THE DESIGN OF A HEAT SHIELD IN AN ISOCHORICALLY OPERATED TOROIDAL DEWAR. Martin, G. D.; Wakefield, K. E. (Princeton Univ., NJ). Advan. Cryog. Eng.; 17: 449-55(1972).

An experimental arrangement is described whereby the experimental time can be increased significantly by enclosing the cryogenic region within a heat shield which is thermally insulated from it and is cooled initially to the same temperature as the cryogenic region. This shield is then enclosed by superinsulation. The relative amounts of insulation, heat shield, and cryogenic space so as to maximize the period of time required for the cryogenic region to traverse the temperature range within which the superconducting state exists are calculated. (MOW)

18635 POSSIBLE PARAMETRIC CAPACITANCE IN JOSEPHSON JUNCTIONS. Zimmerman, J. E. (Inst. for Basic Standards, Boulder, CO). Phys. Lett., A; 42A: No. 5, 375-376(1 Jan 1973).

The capacitance of a Josephson junction is much larger (at least in the low frequency limit) than the classical value $\epsilon A/l$, and is a function of the phase difference θ_0. (auth)

18636 SOME PROBLEMS IN THE DEVELOPMENT OF SUPERCONDUCTING MAGNETIC SYSTEMS. Sychev, V. V. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 39-49(1972). (In Russian).

Basic problems are dealt with which now face specialists working in the area of development and operation of large-scale superconducting magnetic systems. Analysis of problems of the reliability of superconducting magnets shows that providing the necessary reliability of windings is one of the most important questions which must be solved in the development of a large-scale superconducting magnetic system. Winding reliability is ensured by using the principal reliability criteria based on known principles of the origin, existence and propagation of the normal zone when designing the winding and selecting the region of working currents. (JPRS)

18637 IRRADIATION OF SUPERCONDUCTING NIOBIUM CAVITIES WITH PROTONS. Martens, H.; Wholleben, K. (Siemens Research Labs., Erlangen, Ger.). Phys. Lett., A; 42A: No. 5, 393-394(1 Jan 1973).

Electropolished and anodized niobium TE_{011}X-band cavities with Q values up to 2×10^{10} and critical magnetic flux densities B_c^{ac} up to 87 mT were irradiated at room temperature with 1- and 3-MeV protons and fluences up to 1×10^{16} cm^{-2}. Neither the Q values nor B_c^{ac} were influenced by this to any considerable extent. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 18578, 18669, 18670, 18870, 19010, 19032, and 19042.

18638 (IAE–2145) APPROXIMATE EQUATIONS OF NEUTRON THERMALIZATION. Laletin, N. I. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 28p. (In Russian). INIS.

A new form of neutron transport equation obtained previously by the author was applied in the derivation of diverse approximate equations of thermalization. All previously known approximate thermalization equations were obtained from the exact equation. Two possible techniques for the extension of the transformation of the transport equation are demonstrated for the case of a three-dimensional dependence of the neutron flux. (tr-auth)

18639 (IAE–2146) TRANSFORMATION OF THE NEUTRON TRANSPORT EQUATION INTO THE FORM SUITABLE FOR OBTAINING APPROXIMATE THERMALIZATION EQUATIONS. Laletin, N. I. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 28p. (In Russian). INIS.

A transport equation which described the thermalization of neutrons in an infinite, homogeneous medium, was transformed into a form appropriate for obtaining approximate equations of thermalization. Information concerning the process of neutron scattering, which in the original equation entered into the function $\Sigma_s(\epsilon' \rightarrow \epsilon)$, now is included in two functions $i(\epsilon')$ and $g(\epsilon/\epsilon')$. The function $i(\epsilon')$ plays a fundamental role and depends on one variable, and enters into the integral with a variable upper limit. The function $g(\epsilon/\epsilon')$ stands under the integral sign similar to the structure with an integral of collisions of the original equation; the new integral, as a rule, is smaller because it depends on the density of absorption, and not on the scattering density. In consequence of the fact that the function $g(\epsilon/\epsilon')$ in the absence of $\Sigma_s(\epsilon' \rightarrow \epsilon)$ is alternating, a new form of the equation is obtained as more appropriate for the derivation of approximate equations. (tr-auth)

18640 (IFA-DNBR-4) USE OF CUBIC SPLINE FUNCTIONS IN NUCLEAR DATA PROCESSING. Deciu, N.; Rapeanu, S. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 13p. Dep. NTIS (U. S. Sales Only).

Cubic spine functions were used in a program written in FORTRAN IV for an ICL computer for calculations for the scattering spectrum of cold neutrons on liquid benzene and for elastic scattering cross sections on uranium-238 at 10.5 to 21.5 eV. (JFP)

18641 (UCRL–74092) COMPARISON OF ENDF/B III EVALUATED DATA SETS WITH LLL PULSED SPHERE MEASUREMENTS. Haight, R. C.; MacGregor, M. H.; Howerton, R. J.; Plechaty, E. F.; Hansen, L. F. (California Univ., Livermore. Lawrence Livermore Lab.). Aug 1972. 4p. (CONF-720901–15). Dep. NTIS.

From Meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, NY (12 Sep 1972).

The pulsed sphere measurement technique is briefly sketched. Connection between the experimental data and corresponding evaluated data was made by means of the TART Monte Carlo 3-dimensional neutronics code. Some ENDF/B III evaluated data sets showed a deficiency in the number of high-energy inelastically scattered neutrons. A set that does not exhibit this deficiency was constructed. (RWR)

18642 NEW METHOD FOR ANALYSIS OF PULSED FAST-NEUTRON EXPERIMENTS. Ito, S. I. (Atomic Energy Research Lab., Kawasaki, Japan). Nucl. Sci. Eng.; 49: No. 4, 458-67 (Dec 1972).

A new method is presented for investigating the behavior of pulsed fast neutrons in non-multiplying semi-infinite systems. The time- and space-dependent multigroup P1 equation (of the telegrapher's equation type) was analytically solved by the use of the Laplace transform. Starting from the space dependent first time moments on the decaying group-wise neutron fluxes, the propagation parameters are newly defined as the fundamental parameters to describe the characteristics of the fast neutron moderation in the medium. These parameters include the space independent mean lifetime and the inverse of the effective velocity of neutron propagation. The proposed method will be useful in investigating the space dependent neutron slowing down and propagation phenomena in assemblies. (auth)

18643 PULSED NEUTRON EXPERIMENT WITH BERYLLIUM BY THE USE OF A GAMMA-RAY FLASH FROM AN ELECTRON LINEAR ACCELERATOR. Aizawa, Otohiko (Tokyo Inst. of Tech.); Kadotani, Hiroyuki; Kanda, Keiji; Fujita, Yoshiaki; Ito, Shinichi. Nucl. Sci. Eng.; 50: No. 1, 38-45(Jan 1973).

A new method of pulsed neutron experimentation is proposed and successfully applied to a beryllium metal system. The present technique utilizes the γ-ray flash from an electron linear accelerator. The employment of an "internal" neutron source, i.e., the (γ,n) reaction in beryllium, which is "softer" than the often used "external" 14-MeV neutrons from a generator, improves the state of the art of the die-away technique in beryllium. The reduction of background neutrons makes it possible to measure the decay curve until ~1800 μsec after a burst even for a small beryllium assembly of $15 \times 15 \times 15$ cm in dimension (B^2 = 0.101 cm^{-2}), while in earlier experiments the decay curves have been measured only until ~600 μsec for such a small beryllium assembly. The present analysis of decay curves indicates that the assumption made by Kothari, who derived the limit of a discrete decay constant for crystalline moderators, is not valid at least for beryllium. On the other hand, Corngold's limit is consistent with the experimental results. (auth)

18644 STUDIES OF FAST NEUTRON SPECTRA IN TWO REGION SYSTEMS. Gibbs, D. C. Troy, NY; Rensselaer Polytechnic Inst. (1972). 276p. University Microfilms Order No. 72-30,209.

Thesis.

In an effort to expand upon and compliment the integral checks of differential microscopic cross section data of interest to the LMFBR effort, a preliminary experiment on and the numerical model of the fast neutron transport in a two region assembly are described. The fast neutron angular flux spectra are measured by time-of-flight from an aluminum-iron assembly with a planar interface. The neutron source, located in the center of the aluminum region, is pulsed by the R. P. I. electron linear accelerator. Cross sections are handled using ENDF/B-1 data as input, the MC^2 code to obtain a weighting spectrum, and an R. P. I. version of SUPERTOG to develop 49 energy group anisotropic cross section matrices. Transport calculations are performed using the DTF-4 and DOT-IIW S_N codes. The features of the angular spectra near the interface and the propagation of the spectra in both adjacent half-spaces are measured. Few group calculations are performed to test cross section group collapsing recipes and the degree of space-energy coupling within broad groups near the media interface. A fine group spectrum weighted anisotropic cross section collapsing recipe is tested. The degree to which a one dimensional model can be used for analysis is demonstrated. The sensitivity of the experiment to the anisotropic cross section matrices and the details of resonance structure is demonstrated. On the basis of the model calculations, disregard of the anisotropic cross section matrices results in errors of about 5% in predictions of the scalar flux, both for the materials of the experimental assembly and for a sodium–uranium adjacent half-space. From the experimental results, uncertainties in the cross sections of aluminum and iron are evaluated. (Diss. Abstr. Int., B)

18645 PROBLEM OF THE g(ΔE) FUNCTION DERIVATION BY THE METHOD OF SLOW-NEUTRON COHERENT INELASTIC SCATTERING. Gorbachev, B. I.; Ivanitskii, P. G.; Krotenko, V. T. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 1, 45-51(Jan 1972). (In Russian).

The problem was considered on the accuracy of the phonon frequency distribution function derivation from the one-phonon coherent scattering cross section of slow neutrons taking into account irregularity of filling in the first Brilluoin zone by the scattering neutron momentum transfer vector end. It is shown the accuracy estimation existed earlier by the ratio value of the Brilluoin zone volume to the reverse space volume, in which the averaging of the scattering cross section takes place, does not give the correct value of this accuracy. The phonon frequency distribution function of the reverse space range, in which the averaging of the experimental scattering cross section takes place is introduced into the consideration. This function is suggested to check crystal force modes. (auth)

18646 TOTAL CROSS SECTION OF SMALL-ANGLE SLOW-NEUTRON SCATTERING BY FINELY DISPERSED SILICA. Razbudei, V. F. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 1, 34-7(Jan 1972). (In Russian).

The paper presents the total small angle scattering cross section of cold neutrons by amorphous silica with particle diameter ~80 Å. The measured cross section is 10 to 100 times as high as that of scattering by atomic structure and is proportional to λ^2 in accordance with Weiss theory. (auth)

18647 THERMAL-NEUTRON DIFFUSION AT THE ICE–WATER PHASE TRANSITION. Tewari, S. P. (Northwestern Univ., Evanston, IL). Nucl. Sci. Eng.; 50: No. 2, 182(Feb 1973).

Recently Williams and Munno (1971) and Williams (1972) pointed out the absence of discontinuity in the diffusion coefficient, of neutrons at the ice–water phase transition, independent of density change. Their measurements below room temperatures join continuously with those of Silver (1968) in ice. Using a simple model which takes into account chemical binding effect, they assert that neutron scattering from water near the freezing point is the same as that from ice; i.e., water near its freezing point behaves like an infinite ice crystal. In this Letter yet another argument is put forward which supports the view that there is no discontinuity in the diffusion coefficient of neutrons at the ice-water phase transition. (WDM)

18648 INTEGRAL TRANSFORM METHOD FOR THE AVERAGE NEUTRON TRANSPORT PROPERTIES OF A LATTICE. Copic, M. (Univ. of Ljubljana, Yugoslavia). Nucl. Sci. Eng.; 49: No. 3, 370-6(Nov 1972).

A new approach to the determination of average neutron transport properties of regular lattices is presented in a form amenable to any desired order of approximation. It is based on the time dependent one group integro-differential transport equation in which the cross sections are expanded in Fourier series corresponding to the periodicity of the lattice. The integral transform method yields in this case the Fourier series also for the neutron density, the zero'th term of which is separated out as the average over the lattice. The remaining Fourier coefficients are solved by a method analogous to the collision probability method and expressed in terms of the angular moments of the average neutron density. An approximate integral transform of the transport equation for the average neutron angular density is obtained that contains through its effective scattering integral the effects of the anisotropy and of the heterogeneity of the lattice. The method is applied to the problem of anisotropic diffusion constants in lattices containing voids, in particular, the diffusion constant parallel to empty channels at large channel radia is resolved. As an example, the simultaneous determination of the disadvantage factor and the anisotropic diffusion constant is also presented. (auth)

18649 TIME-DEPENDENT LEAKAGE NEUTRON SPECTRUM STUDIES OF SOME SMALL HYDROGENOUS MODERATORS. Graham, K. F.; Carpenter, J. M. (Univ. of Michigan, Ann Arbor). Nucl. Sci. Eng.; 49: No. 4, 418-37(Dec 1972).

Measurements of the time and energy dependence of the spectrum of slow neutrons emerging from small pulsed moderators are reported. The results are presented with absolute normalization. The techniques made measurements possible using a 150-keV Cockroft–Walton D–T neutron generator, producing 10^{11} n/sec (peak). Energy spectra and time distributions at various energies are reported for slabs of polyethylene at 296°K, and polyethylene, solid ammonia, and solid methane at 77°K. Variations of yield with overall moderator thickness are described. The effects on spectra and time distributions are elucidated by a series of measurements with cadmium heterogeneous poison at various depths beneath the moderator surface. Cadmium and gadolinium heterogeneous poisons, which differ in the energy below which the poison is effective, are compared. Results are useful for pulsed moderator design, and as tests of neutron scattering kernels and methods of calculation. (auth)

18650 DIFFRACTION OF COLD NEUTRONS ON FERROMAGNETIC BLOCH'S WALLS. INELASTIC SCATTERING. Bushev, M. K. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 2, 149-7(1972). (In Russian).

Macroscopic conclusions were drawn from spectra of "spatial" and localized spin waves in a Bloch wall. The quantity which should play a role of heat factor (in the case of scattering by Bloch walls) was determined. The cross section of inelastic neutron scattering with participation of spin waves was found. The experimental method is discussed with which the law of dispersion of these waves may be determined. (tr-auth)

18651 PULSED NEUTRON EXPERIMENTS ON GRAPHITE SYSTEM. Aizawa, Otohiko (Tokyo Inst. of Tech.); Fukano, Yoshinobu; Sato, Haruo; Takeda, Eiichi; Kanda, Keiji. Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 109, 1-17(Mar 1972).

A pulsed neutron experiment was performed on graphite systems to show various effects on the decay constant λ. Pulsed neutrons of 14 MeV were produced by the T(d,n)α reaction, and injected into moderator systems. Width of the neutron pulses was 25 μsec or 100 μsec, and their repetition frequency was 50 or 100 Hz. A reactor chopper experiment was also performed with neutrons from a heavy water thermal neutron facility of a 5 MW research reactor. Decay curves were obtained for the various dimensions of the graphite systems. The results were compared with calculated values of the instantaneous decay constant for the various dimensions, as a function of waiting time after neutron burst. The calculated values were in good agreement with the experimental values, except for a few systems. Other comparison was made for the decay constant as a function of buckling and for the time variation of the instantaneous decay constant. A neutron energy spectrum at 10 msec after burst and time dependent energy spectra is shown. The asymptotic decay constant could be obtained for large systems with fairly long waiting time after burst, while it could not be obtained for small systems. The calculation also confirmed these results. (JA)

18652 TIME-ENERGY EXPERIMENTAL STUDY OF HOMOGENEOUS NON-MULTIPLYING ASSEMBLIES BY A PULSED FAST NEUTRON SOURCE. Deconninck, G.; Monseu, Ph. (Univ., Louvain, Belgium). J. Nucl. Energy; 26: No. 11, 537-48(Nov 1972).

The time-energy behavior of fast neutrons was studied in cubic assemblies of carbon, aluminum, iron, and lead, with a plane monoenergetic pulsed wave of neutrons impinging on the face of the cube. Two other measurements were performed on a graphite sphere, with a central isotropic source, and on a slab of graphite, with plane source. The source energy was chosen in the range of 1.66 to 2.06 MeV. A stillbene detector was used as the neutron spectrometer. The neutron spectrum was measured, mostly on the front or the back face of the assembly, with an energy resolution of 200 keV. The results of the spherical geometry measurement were compared with a Monte-Carlo calculation: the agreement was fairly good. The other results show up the effect of the inelastic scattering (doubly peaked neutron spectrum) and of the valleys or the peaks in the total cross sections. (auth)

18653 NEUTRON SPIN ECHO: A NEW CONCEPT IN POLARIZED THERMAL NEUTRON TECHNIQUES. Mezei, F. Institut Max von Laue-Paul Langevin, Grenoble, France). Z. Phys.; 255: No. 2, 146-60(1972).

A simple method to change and keep track of neutron beam polarization nonparallel to the magnetic field is described. It makes possible the establishment of a new focusing effect called neutron spin echo. The technique, developed and tested experimentally, can be applied in several novel ways, e.g., for a neutron spin flipper of superior characteristics, for a very high resolution spectrometer for direct determination of the Fourier transform of the scattering function, for generalized polarization analysis, and for the measurement of neutron particle properties with significantly improved precision. (7 figures) (auth)

18654 ADJUSTMENT OF GROUP CROSS SECTIONS BY MEANS OF INTEGRAL DATA. II. NUMERICAL STUDY. Mitani, H.; Kuroi, H. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 642-57(Nov 1972).

Adjustment of the ABBN set is performed using various integral data obtained from fast critical experiments; through this adjustment, some practical properties are also examined in detail. The correlation coefficient between group cross sections is numerically obtained by assuming that the compound nucleus formation cross section can be described by a statistical model. The effect brought by this correlation to the adjustment of group cross sections is also studied. When the differential and integral data used in the adjustment contain a systematic error, the normalized sum of squares of residuals has a non-central Chi-square distribution. This is numerically examined by generating artificial differential and integral data with the aid of random numbers. The ABBN set collapsed into 15 energy groups is adjusted, and the principal results are compared with the measurements. The reliability of the adjusted integral data and group cross sections is also studied. (auth)

18655 EFFECTS OF ANISOTROPIC HOLE SYSTEMS ON NEUTRON STREAMING IN A MODERATOR. II. Takeda, T.; Sekiya, T. (Osaka Univ., Suita, Japan). Technol. Rep. Osaka Univ.; 22: 11-19(Feb 1972).

The authors derive a new method of calculating the anisotropic second spatial moment of the neutron distribution in an infinite moderator including a regular array of holes in a square configuration. In the calculation of the moment, the first flight of neutrons is taken into consideration exactly through the square mean free path, and the angular correlation of different paths is expressed by the product of the mean free paths at different energies and the anisotropic component of the scattering cross section. (auth)

18656 EIGENFUNCTIONS EXPANSION METHOD FOR NEUTRON WAVE PROPAGATION PROBLEM. II. PSUEDO MODE CALCULATION. Yamagishi, T.; Sekiya, T. (Osaka Univ., Suita, Japan). Technol. Rep. Osaka Univ., 22: 1-9(Feb 1972).

A homogeneous form of the Boltzmann equation with a cutoff

cross section in the neutron wave propagation problem is solved by the eigenfunctions expansion method in an infinite system. By numerical calculations of the continuum contributions, the effect of cold neutron streaming on the neutron amplitude is revealed. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 18669, 18682, 18806, and 18835.

18657 INVESTIGATION OF THE DEPENDENCE OF NEUTRON YIELD OF REACTIONS D(d,n)^{3}He AND T(d,n)^{4}He ON IRRADIATION TIME. Pivarc, J. (Slovenska Akademia Ved, Bratislava). Fyz. Cas.; 22: No. 3, 170-178(1972).

The dependence of the neutron yield from deuterium and tritium targets on the irradiation was investigated experimentally. An explanation is given of the increase in the neutron yield at the beginning of the irradiation time with the increase in the temperature of the titanium target layer, saturated by deuterium or tritium, respectively. The apparatus for the neutron yield determination and the measuring method are described. (auth)

18658 FAST TIMING TECHNIQUES AND NEUTRON REACTIONS. Johnson, P. B. (Victoria Univ., Wellington, New Zealand). pp 190-8 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The application of fast timing coincidence techniques to the D(d,n) reaction and to n−γ angular correlations from charged-particle induced reactions is discussed. (JWR)

18659 MICROSCOPICALLY SUBSTANTIATED OPTICAL POTENTIAL FOR THE α-t SYSTEM, INCLUDING NUCLEON EXCHANGE. Neudatchin, V. G.; Kukulin, V. I.; Boyarkina, A. N.; Korennoy, V. P. (Inst. of Nuclear Physics, Moscow). Lett. Nuovo Cim.; 5: No. 12, 834-8(18 Nov 1972).

It was previously found that there exists a deep local l-independent optical potential of the α−α interaction which describes the energy dependence of scattering phases just as well as the resonating-group method. A similar approach is applied to the α−t system taking into account the possibility of the proton transfer from α to t which may be multiple if the collision is sufficiently slow and close. This is the effect of nucleon resonance exchange. (JFP)

18660 MULTIPLE SCATTERING OF SLOW NEUTRONS. Padureanu, I. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 7, 775-782(1972). (In Rumanian).

A formula is given for calculating the multiple scattering correction for the slow neutrons for total cross sections, obtained by the determination of the neutron transmission starting from the diffusion equation. The multiple scattering is represented as a function of $\tau(\tau = \Sigma_T \cdot t)$ in the case of the hydrogenous substances for which the "albedo" is roughly equal to one. The total effect of the multiple scattering for methyl alcohol (CH_3OH) in the energy range 1.27 to 6.67 meV is estimated. (4 figures, 2 tables) (auth)

18661 ANALYSIS OF THREE-NUCLEON SCATTERING USING FADDEEV EQUATIONS UP TO THIRD ORDER. Durand, M. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A201: No. 2, 313-325(1973).

The Faddeev equations for three nucleons are iterated up to third order using separable interactions: the Tabakin potential for the first order and the Yamaguchi potential for the other orders. This method is applied to the quasi-free scattering ^{2}H(p,2p)n and ^{2}H(p,np)p. Apparent convergence of the rescattering series is obtained for incident lab energies $E_{lab} \gtrsim 40$ MeV, and the shape and magnitude of the experimental results are thus reproduced. (auth)

18662 ODD-EVEN ABSORPTION IN ^{3}He + ^{3}He SCATTERING AND LEVEL STRUCTURE OF ^{6}Be. Thompson, D. R.; Tang, Y. C.; Koepke, J. A.; Brown, R. E. (Univ. of Minnesota, Minneapolis). Nucl. Phys.; A201: No. 2, 301-312(1973).

Differential cross sections for ^{3}He + ^{3}He elastic scattering are calculated at c.m. energies from 2.95 to 37.44 MeV using the one-channel resonating-group method. A phenomenological imaginary potential, whose strength depends on whether the relative orbital angular momentum is even or odd, is included in order to account approximately for open reaction channels. The introduction of such an odd-even feature leads to a significantly improved agreement with experiment, especially at the larger scattering angles. In addition, an analysis of the calculated resonant phase shifts confirms recent experimental observations of highly excited levels in ^{6}Be. (auth)

18663 SOLUTION OF THE NUCLEAR THREE-BODY PROBLEM WITH RELATIVISTIC POTENTIALS. Demin, V. F.; Efros, V. D. JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 360-363 (20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 504-508(20 Oct 1972).

The hyperspherical approach is used to find the resultant properties of the tritium nucleus using two realistic NN potentials, fitted to the NN scattering phase shifts in a large energy interval. The binding energy of the ^{3}H nucleus is found. (JFP)

18664 ^{2}H(γ,p) ABSOLUTE CROSS SECTION AND ANGULAR DISTRIBUTION AT 17 TO 25 MeV. Baglin, J. E. E. (Ames Lab., Iowa); Carr, R. W.; Bentz, E. J. Jr.; Wu, C. P. Nucl. Phys.; A201: No. 3, 593-607(1973).

The absolute differential cross section for the ^{2}H(γ,p)n reaction was determined for lab angles of 20°, 45°, 65°, 90°, 115°, 135° and 160°, through the excitation energy range from 17 to 25 MeV. The estimated experimental uncertainty in cross-section values is ±6%. The total cross section is observed to be 20% lower than that calculated by Partovi; angular distribution coefficients also depart appreciably from expected values. Major disagreements appear to originate in the E1 isotropic term and the triplet M1 component of the theory. (auth)

18665 CALCULATION OF INELASTIC ELECTRON FORM FACTORS OF ^{3}H AND ^{3}He NUCLEI BY THE HARMONIC POLYNOMIAL METHOD. Kozlovskii, I. V.; Tartakovskii, V. K. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1893-1901(Nov 1972). (In Russian).

Inelastic scattering by high-energy electrons by three-nucleon nuclei is considered. The inelastic electron form factors of ^{3}H and ^{3}He nuclei are calculated as functions of momentum transfer by using the harmonic polynomial method (K-harmonic method). The general formulas are obtained for the inelastic form factors in terms of radial wave functions in approximation taking into account the harmonics with K = 0 and K = 2. The radial wave functions for a square-well potential are used in numerical calculations. The contribution of mixed symmetry slates to the wave functions of ^{3}H and ^{3}He nuclei as well as the contribution of convectional nuclear current are estimated. The calculated inelastic cross sections are compared with available experimental data. (6 figures) (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 18242, 18310, 18662, 18688, 18715, 18775, 18791, 18806, 18810, 18816, 18835, 18858, and 18868.

18666 (FRNC-TH-296) STUDY OF ^{19}F USING SCATTERING OF 30 MeV PROTONS. DETERMINATION OF THE STATIC DEFORMATIONS OF ^{19}F, ^{20}Ne, AND ^{21}Ne. Genoux-Lubain, Alain (Grenoble Univ. (France)). 1972. 115p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The elastic and inelastic scattering of 30-MeV protons by ^{19}F was analyzed using optical models and the DWBA . The static deformations of ^{19}F, ^{20}Ne, and ^{21}Ne were studied using the coupled-equation method in the framework of the rotational model. It seems probable that the ground-state rotational bands K = $\frac{1}{2}^+$ of ^{19}F and K = $\frac{3}{2}^+$ of ^{21}Ne can be considered pure. This analysis enabled the strong hexadecapole deformation of ^{20}Ne to be confirmed. It appears that this nucleus plays a very special role in the (s,d) shell: its immediate neighbors (^{19}F and ^{21}Ne) do not exhibit this very strong deformation. The deformation of ^{19}F is similar to that of ^{18}O, and that of ^{21}Ne, similar to that of ^{22}Ne. Hexadecapole deformation thus seems to be very sensitive to the addition of a hole or particle to ^{20}Ne. (France)

18667 (JINR-P1-6796) STUDY OF THE ABSORPTION REACTIONS OF STOPPED π^--MESONS BY NITROGEN NUCLEI WITH THE ^{8}Li PRODUCTION. Agababyan, N. M.; Batusov, Yu. A.; Bunyatov, S. A.; Genchev, V. I.; Golovanova, N. F.; Gulkanyan, H. R.; Sidorov, V. M.; Chernev, Kh. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The absorption reactions of stopped π^--mesons by nitrogen nuclei with the ^{8}Li production were studied by using the photoemulsion method. Relative probabilities of reactions are determined. The energy and angular distributions, as well as dis-

tributions over effective masses of particle combinations, were constructed for two reactions with the most relative probability. The theoretical analysis of these reactions has been carried out. The comparison of theoretical calculations with experimental data shows that in the capture of stopped π^--mesons by nitrogen nuclei with the ^{8}Li production the absorption on (pp) pair and complex clusters (^{3}Li, ^{5}Li, ^{6}Be) play an essential role. (auth)

18668 (JINR-P1-6797) ABSORPTION OF STOPPED π^--MESONS BY O NUCLEI WITH THE ^{8}Li PRODUCTION. Agababyan, N. M.; Batusov, Yu. A.; Bunyatov, S. A.; Genchev, V. I.; Golovanova, N. F.; Gulkanyan, H. R.; Chernev, Kh. M.; Sidorov, V. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The absorption reactions of stopped π^--mesons by oxygen nuclei with the ^{8}Li production were studied by using the photoemulsion method. Relative probabilities of the reactions are determined. The energy and angular distributions are constructed for the reaction $\pi + {}^{16}O \rightarrow {}^8Li + {}^4He + {}^2H + p + n$. The theoretical analysis of this reaction is carried out from the view of π^--meson absorption by nucleon cluster of ^{4}Li. Comparison of the theoretical calculations and experimental data shows that in this reaction, as well as in the reaction on carbon, the mechanism of π^--meson absorption by 4-nucleon cluster of ^{4}Li takes place. (auth)

18669 (LA-DC-72-1412) ^{3}He(n,p)T, ^{6}Li(n,α)T, AND ^{10}B(n,α) STANDARD CROSS SECTIONS. Stewart, Leona (Los Alamos Scientific Lab., N. Mex.). [nd]. 16p. (CONF-721127-2). Dep. NTIS.

From 2nd IAEA panel on neutron standards reference data; Vienna, Austria (20 Nov 1972).

The evaluated cross sections in the ENDF/B-III library are reviewed and compared with recent experimental measurements over the energy range established for each standard cross section. While the ^{3}He(n,p), ^{6}Li(n,α), and ^{10}B(n,α) cross sections seem to be adequately established up to approximately 10 keV, the ^{10}B data should be separated into the α_0 and α_1 channels, a procedure now allowed by a recent ENDF format revision. All of the cross sections require further study above 10 keV to gain the precision necessary for standards. Recent experiments on ^{10}B carried out at GRT are briefly discussed, and the results presented. (8 figures) (auth)

18670 (ORNL-4823) TEST OF NEUTRON TOTAL CROSS-SECTION EVALUATIONS FROM 0.2 TO 20 MeV FOR C, O, Al, Si, Ca, Fe, AND SiO_2. Perey, F. G.; Love, T. A.; Kinney, W. E. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 90p. (ENDF-178). Dep. NTIS.

Neutron transmission measurements from 0.2 to 20.0 MeV were made for the shielding materials carbon, oxygen, aluminum, silicon, calcium, iron, and the compound silicon dioxide. The measurements were performed at the ORELA Shield Test Station with a resolution of about 0.12 ns/meter on sample thicknesses varying from 0.65 to 0.9 atoms/barn. The transmission measurements were compared with the predictions obtained from the Defense Nuclear Agency evaluated cross-section library. Since the total cross-section files for these elements are also the ones present in the ENDF/B-III library, its total cross-section files for all of the elements with the exception of oxygen are also checked. There are serious discrepancies between the experimental data and the predictions based on the evaluated files. These discrepancies are often large in the energy region from 0.2 to 0.6 MeV. (62 figures, 3 tables) (auth)

18671 EFFECTIVE CROSS SECTION FOR THE ^{16}O(d,n)^{17}F REACTION FOR FISSION NEUTRONS MODERATED BY HEAVY WATER. Pruys, H. S.; Ganapol, B. D. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). Nucl. Sci. Eng.; 50: No. 1, 79-80(Jan 1973).

The effective cross section for the ^{16}O(d,n)^{17}F reaction for fission neutrons moderated by D_2O has been calculated, using the recoiling deuteron formalism of Hammar and Forsén. A value of $\Sigma_n = 4.8 \times 10^{-7}$ cm^{-1} is reported. (auth)

18672 ISOSPIN MIXING IN ^{18}F. Richards, H. T. (Univ. of Wisconsin, Madison). Rev. Brasil. Fis.; 2: No. 1, 213-40(1972). (COO-7-619).

Research on ^{18}F levels by the ^{16}O + d and ^{14}N + α channels is discussed. Excitation functions for the ^{16}O(d,α) reaction at 2 to 14 MeV and the ^{14}N(α,α_1) reaction at 10 to 13 MeV are presented. The lack of isospin conservation in these reactions is examined. (JWR)

18673 ISOSPIN MIXING IN ^{14}N AND THE REACTION MECHANISM. Richards, H. T. (Univ. of Wisconsin, Madison). Rev. Brasil. Fis.; 2: No. 1, 241-53(1972). (COO-7-618).

The ^{12}C(d,α) reaction was studied to obtain information on the reaction mechanism and on isospin mixing in ^{14}N resonances. Angular distributions and excitation functions were obtained at deuteron energies of 7 to 14 MeV. The results are explained assuming a compound nucleus mechanism. (JWR)

18674 CROSS SECTION FOR ANTIDEUTERON ABSORPTION BY NUCLEI AT HIGH ENERGIES. Teku, A. B. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 362-364(1972). (In Russian)

Calculated and experimental values were compared for the cross sections of absorption of antideuterons (CSAA) at momenta of 25 GeV/c by the nuclei ^{6}Li, ^{12}C, ^{27}Al, ^{64}Cu, and ^{208}Pb. The CSAA by ^{208}Pb at a momentum of 25 GeV/c was twice as large as at 20 GeV/c. The results of calculating CSAA by the use of two different equations were also compared. (1 figure, 2 tables) (KSW)

18675 EXCITATION OF GIANT MULTIPOLE RESONANCES L = 1 to 4 IN THE ^{16}O(p,p') SPIN-FLIP TRANSITION. Geramb, H. V.; Sprickmann, R.; Strobel, G. L. (Kernforschungsanlage, Juelich, Ger.). Nucl. Phys.; A199: No. 3, 545-59(1973).

An investigation of inelastic proton scattering to the 2^- 8.88-MeV state in ^{16}O is presented in an energy range between 23 and 46 MeV. Transition matrix elements are evaluated within the antisymmetrized DW theory. The two-step exchange resonance mechanism is included by applying the deformed-potential model. Good agreement with all data is obtained by adjusting the coupling constants in a least-squares search. The values obtained reflect four pronounced resonances, which are identified with giant multipole resonances in ^{16}O. (auth)

18676 SPIN-PARITY ASSIGNMENTS OF EXCITED STATES IN ^{12}C. Jacquot, C.; Sakamoto, Y.; Jung, M.; Girardin, L. (CRN, Strasbourg,). Nucl. Phys.; A201: No. 2, 247-263(1973).

The reaction $^{12}C(\alpha,\alpha')^{12}C^*(3\alpha)$ is observed by using 90-MeV α-particles in ionographic matter. The energies of the three α-particles from the break-up of ^{12}C* are plotted in Dalitz diagrams. The density distributions for the three α-particles in the diagrams are calculated by assuming the spins and parities for the states in $^{12}C^*(3\alpha)$. The spin-parities for the states are assigned by comparing the observed density distributions with those calculated. (auth)

18677 RESONANCE IN ^{12}C AT 18.13 MeV OBSERVED IN ^{11}B(p,γ)$^{12}C^*_{15.1}$. Suffert, M.; Feldman, W.; Hanna, S. S. (Stanford Univ., CA). Particles Nucl.; 4: No. 4, 175-91(Oct 1972).

A resonance in ^{12}C at $E_x = 18.13$ MeV was observed in the reaction $^{11}B(p,\gamma)^{12}C_{15.1}(\gamma)^{12}C$ at $E_p = 2.37$ MeV. The width is $\Gamma_{cm} = 0.60 \pm 0.10$ MeV, and cross section on resonance is $\sigma_r = 0.77 \pm 0.15$ μb. The observed properties and angular correlation measurements are fitted best by an assignment of $J^\pi = 1^+$, T = 0. Interference with a non-resonant background, however, makes the assignment uncertain. (10 figures, 2 tables) (auth)

18678 ^{11}B(n,α)^{8}Li(β^-)^{8}Be*(2α) REACTION FOR 25 AND 38 MeV NEUTRONS. Kim, C. Y. (Univ. of Calgary, Alberta). Can. J. Phys.; 50: No. 21, 2674-2677(1 Nov 1972).

Boron-loaded K-2 emulsions were exposed to the neutrons produced by 41-MeV protons incident upon a deuterated polyethylene target. The developed emulsions were scanned for the resulting "hammer tracks" produced from the ^{11}B(n,α)^{8}Li(β^-)^{8}Be*(2α) reaction. Measurements were made of the range and space angles of these events. The neutron cross section for this reaction was found to be 0.098 ± 0.057 mb for 37.7 ± 3.3 MeV neutrons and 1.87 ± 0.75 mb for 25.0 ± 3.0 MeV neutrons. (auth)

18679 BOUND STATE FOR SYSTEMS OF THREE AND FOUR α PARTICLES. Berezhnoi, Yu. A.; Soznik, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1837-1841(Nov 1972). (In Russian).

By using various two-particle phenomenological potentials found from the analysis of the interaction of two α-particles, the existence of a bound state for systems of three and four α particles is considered on the basis of K harmonics. The analysis of the K-harmonics method is shown to indicate the absence of a bound state for systems of three and four α-particles. Research on the existence of a bound state for systems of α particles using different methods is discussed. (2 figures) (auth)

18680 POLARIZATION OF PROTONS, SCATTERED ON Be, C, Al, Pb NUCLEI AT E_p = 1000 MeV. Vovchenko, V. G.; Zhdanov, A. A.; Zheleznyakov, V. M.; Fedorov, O. Ya.; Shvedchikov, A. V. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 16: No. 6, 1145-1149(1972). (In Russian).

Polarization of protons, scattered on Be, C, Al, Pb nuclei, has been measured for the angular range 4–12°. After the example of carbon, it has been shown that in the range of small angles (4–7.5)° there dominates elastic scattering on nuclei, which is the one that determines polarization behavior. Angular depen-

dence of polarization on other nuclei coincides with carbon with an accuracy up to the influence of Coulomb scattering. (auth)

18681 NUCLEAR SPECTROSCOPY WITH DIRECT REACTIONS INDUCED BY HEAVY IONS. Von Oertzen, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 3-42 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

After an introduction in which the reasons for studying heavy-ion-induced nuclear reactions are set forth, one-nucleon-transfer reactions are taken up. The DWBA has been used to analyze sub-Coulomb transfer reactions; under certain conditions, the same approach can be used for calculating transition amplitudes for reactions above the Coulomb barrier. Reactions of B, N, and O ions with light nuclei are discussed, including the extraction of spectroscopic factors. The effects that arise from the neglect of the terms of the order (nucleon mass/nuclear mass) in the coordinates of the transition amplitude (recoil effects) are discussed. The value of L_p will be appreciable at high energies in heavy-ion reactions where the angular momenta of grazing collision attain values of 30 to 50 units of $\hbar$. This fact can lead to a preferential population of single-particle states with orbital quantum numbers equal to L_p. The presence of the angular momentum L_p can further lead to an increased mismatch in angular momentum space and thus lead to a damping of structures in angular distributions. Especially at smaller scattering angles where the kinematical momentum transfer is small, L_p attains its maximum value and can give rise to strong populations of high-spin states. Next, the structural factors of multinucleon-transfer reactions are discussed. Consideration of the factors K_i and K_f (giving the probability of the formation of the state of the k nucleons with the given inner quantum numbers) leads to several predictions related to features of experimental spectra: (a) the values of K_i and K_f, when summed over all intermediate states involving a change of internal quantum number (n,l) in the transition are as a rule much smaller than those which involve no change; (b) if the Young scheme of the particles is changed during the transfer process, the cross section is either zero or very small; (c) the cross section is maximum if the angular momentum quantum numbers of the transferred nucleons are identical in the initial and final states; the cross section is maximum if L_k and $L_{\bar{k}}$ have maximum values; (d) transitions with pronounced structure in the angular distributions as a rule will be the results of only very few amplitudes in the sum for the differential cross section. These transitions, then, correspond to transfer reactions where the internal quantum numbers and the Young scheme have not changed during the transfer, and both states have unique and simple structure. Several examples of three- and four-nucleon-transfer reactions are given; they either prove the above predictions through known structure of the states involved or give qualitative structural information by their application. Finally, nuclear-structure effects in the elastic scattering of nuclei by nuclei (rearrangement processes) are discussed. For a reasonable discussion of the rearrangement processes, it is necessary to have a good knowledge of the pure potential scattering; and for the study of potential scattering it is necessary either to find systems in which contributions from rearrangements are negligible, or to restrict the analysis of the data to angular regions in which the interference with other processes is small. For the description of adiabatic rearrangement processes occurring in collisions at energies in the vicinity of the Coulomb barrier, the system can be adequately described by adiabatic wave functions. In the approach used the core–core potential is taken to be the empirically determined complex potential and the adiabatic energies of the molecular states are obtained by using the method of linear combination of the nuclear shell-model orbitals. As a final point, the semiclassical aspects of the rearrangement processes in elastic scattering are discussed. (30 figures, 2 tables) (RWR)

18682 GROUND-STATE PROPERTIES OF LIGHT NUCLEI AS DEDUCED FROM VARIATIONAL CALCULATIONS. Boffi, S. (Univ., Pavia, Italy). pp 329-335 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

A review is presented of recent work done in Pavia on ground-state properties of light nuclei as deduced from variational calculations. Special attention is devoted to the single-particle density; three methods are analyzed to deduce it. In the framework of Hartree–Fock theory, first-order contributions to the ground-state function are shown to be negligible in the case of ^{4}He. The projection of good quantum numbers from the initial Slater determinant before variation was compared with the Hartree–Fock method in the case of parity, and considerable energy gain was achieved. A variational procedure is proposed to determine the single-particle reduced density matrix by a best fit to the experimental data, with the conclusion that, in the case of ^{4}He, even a finite linear combination of Slater determinants seems inadequate to describe all ground-state properties. (1 figure) (auth)

18683 s–d-SHELL-MODEL STUDY FOR A = 18 TO 22. Halbert, E. C.; McGrory, J. B.; Wildenthal, B. H.; Pandya, S. P. (Oak Ridge National Lab., TN). Advan. Nucl. Phys.; 4: 315-442.

Using the full basis of Pauli-allowed $(0s)^4(0p)^{12}(1s,0d)^{A-16}$ states, conventional shell-model calculations were performed for A = 18 to 22. Seven alternative (1 + 2)-body Hamiltonians were used. Two of these were the "realistic" Hamiltonians proposed by Kuo and Brown, and by Kuo, for A = 18. Five others were obtained by choosing five different adjustable forms for the (1 + 2)-body Hamiltonian operator, and then optimizing the free parameters in these forms so as to get least-square fits to measured energy-level data in A = 17 to 22. For levels which seem to be members of ground-state bands, all seven Hamiltonians yield fair-to-good reproduction of experimental data for the following kinds of observables: excitation energies, spectroscopic factors for single-nucleon transfer, electric quadrupole moments, intraband B(E2) strengths, and magnetic moments. Within ground-state bands there is generally very striking similarity between the shell-model E2 results, and the E2 results predicted by a strong-coupling rotational model. This general similarity, and the exceptions to it, can be explained qualitatively by arguments involving SU_3 shell models. For observables involving levels outside ground-state bands, the agreement with experiment is spotty and there is considerable sensitivity to the choice among the seven Hamiltonians. Again, SU_3 considerations are helpful in explaining these features. Some very simple shell models can account for the pattern of weakness and strength seen among the shell-model B(M1) value. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 18666, 18670, 18674, 18680, 18682, 18683, and 18852.

18684 (CONF-730301-2) FAST NEUTRON CAPTURE CROSS SECTIONS FOR SILICON. Allen, B. J.; Macklin, R. L. (Oak Ridge National Lab., Tenn.). 1972. 2p. Dep. NTIS.

Total neutron capture measurements at 2.5 to 1404 keV were made with a 0.027 atom/barn sample of natural Si with an energy resolution of about 0.2% (fwhm). Resonance energies and parameters were measured. (1 table) (RWR)

18685 (LA-4726) PRELIMINARY EVALUATION OF THE NEUTRON AND PHOTON-PRODUCTION CROSS SECTIONS FOR ALUMINUM. Young, P. G.; Foster, D. G. Jr. (Los Alamos Scientific Lab., N. Mex.). Dec 1972. Contract W-7405-eng-36. 42p. (ENDF-175). Dep. NTIS.

A preliminary evaluation of the neutron cross sections of ^{27}Al was completed for the energy range 10^{-5} eV to 20 MeV. The evaluation includes specification of energy and angular distributions for secondary neutrons and photons. The recommended data are based mainly on experiment, and extensive comparisons with measured results are provided. In certain areas model calculations were used to augment the experimental data. The evaluated results are available on magnetic tape in ENDF/B(III) format. (59 figures, 6 tables, 174 references) (auth)

18686 (ORNL-TM-4032) TESTING OF PHOTON PRODUCTION DATA FROM ENDF/B-III MATERIAL 1135 (ALUMINUM). Ford III, W. E. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 66p. (ENDF-180). Dep. NTIS.

Photon-production data in the Evaluated Nuclear Data File (ENDF/B-III) for ^{27}Al, MAT 1135, were tested by (1) comparing the thermal-neutron capture gamma-ray yields calculated with MAT 1135 with data from the literature, (2) comparing gamma-ray pulse-height spectra calculated with MAT 1135 with measured spectra, and (3) comparing the secondary gamma-ray production cross sections calculated with MAT 1135 data with cross sections from the literature. (auth)

18687 STUDY OF THERMAL NEUTRON CAPTURE IN ALUMINUM. Ishaq, A. F. M.; Colenbrander, A. H.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 22, 2845-2855(15 Nov 1972).

The gamma-ray spectrum following thermal neutron capture in aluminum was studied using a Ge(Li) pair spectrometer. A total of 143 transitions was observed above 2.1 MeV, and most of these were placed in a decay scheme. Some 51 levels in ^{28}Al are observed to be populated in the reaction. The Q value for the ^{27}Al(n,γ)^{28}Al reaction is estimated to be 7725.4 ± 0.5 keV, and

the multiplicity is found to be 2.0. The mean relative strengths of primary E1 and M1 transitions were calculated and an attempt was made to use these to determine the multipolarities of primary transitions leading to levels of unknown parity. (auth)

18688 LIFETIME MEASUREMENT OF THE FIRST EXCITED STATE IN ^{22}Ne. Sztark, H.; Quebert, J. L.; Gil, P.; Marquez, L. (Bordeaux Univ., Gradignan, France). J. Phys. (Paris); 33: No. 10, 841-845(Oct 1972).

The mean lifetime of the first excited state of ^{22}Ne (2^+, 1.277 MeV) was measured using the recoil path method and the ^{19}F(α,pγ)^{22}Ne reaction at low energy. The γ radiation was recorded in coincidence with the protons emitted at an angle of 170° with respect to the incident beam. The mean lifetime was determined to be 5.9 ± 0.6 ps. (France)

18689 FLUCTUATION ANALYSIS OF THE ^{29}Si(d,p$_0$)^{30}Si REACTION. Bakr, M. H. S.; Ali, M. A.; Omar, H. M. (Atomic Energy Establishment, Cairo). ATOMKI (At. Kut. Intez.) Kozlem.; 14: No. 3, 189-196(1972).

The ^{29}Si(d,p$_0$)^{30}Si reaction was investigated in the deuteron energy range 2.00 to 2.50 MeV. Excitation functions of the transition to the ground state of ^{30}Si were measured in steps of 10 keV at different observation angles. Fluctuation analyses of the cross sections were performed in terms of Ericson's theory. Autocorrelation functions were calculated. The mean coherence width (Γ = 19 ± 5 keV) in the compound nucleus ^{31}P at 18 MeV excitation energy was deduced as a result of the fluctuation analysis. The direct reaction portion of the cross sections was found to be about 90%. (5 figures, 1 table). (auth)

18690 ISOSPIN-FORBIDDEN ANALOG RESONANCES IN ^{33}Cl. II. Levels of ^{35}Cl and Higher T = 3/2 Resonances. Abbondanno, U. (Univ., Trieste, Italy); Lagonegro, M.; Pauli, G.; Poiani, G.; Ricci, R. A. (Nuovo Cim. 13A: No. 2, 321-342(21 Jan 1973).

The higher T = 3/2 analog resonances in ^{33}Cl have been investigated as compound resonances formed by the elastic and inelastic scattering of protons from the ^{32}S nucleus, which are forbidden by the isospin conservation law. Good evidence has been obtained of an analog resonance, with $J^\pi = 3/2^+$, at incident proton energy of E_p = (4855 ± 3) keV, and of an analog resonance with $J^\pi = 3/2^+$ at proton energy E_p = (5284 ± 3) keV. The energy interval from E_p = 4000 keV to E_p = 5500 keV has been investigated, and energy, angular momentum, spin and parity are proposed for twenty-three levels of ^{33}Cl. Details are given on the computation methods used for the analysis. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 18670, 18715, 18716, 18719, 18815, 18845, 18851, 18852, 18861, and 18867.

18691 (COO-3464-10) NUCLEAR STRUCTURE STUDIES. Technical Progress Report, January 1, 1972–December 31, 1972. Preiss, I. L. (Rensselaer Polytechnic Inst., Troy, N. Y.). Jan 1973. Contract AT(11-1)-3464. 19p. Dep. NTIS.

Experimental programs are summarized including facilities, energy levels of ^{56}Co from decay of ^{56}Ni, decay of ^{49}Cr, level structure of ^{105}Ag, isomers of ^{68}Se, isomerisms in ^{70}Se, x-ray fluorescence and chemical separation, transfer studies, resonance fluorescence from 7.08-MeV state in ^{208}Pb, and electron beam studies of x-ray yields. (WDM)

18692 (FRNC-R-17) ROTON AND SHELL-MODEL 0^+ STATES FOR (4p–4n) SYSTEM IN THE $f_{\frac{7}{2}}$ SHELL. Richert, J. (Centre National de la Recherche Scientifique, Strasbourg (France). Laboratorie de Physique Theorique). 1971. 11p. Dep. NTIS (U. S. Sales Only).

The Hamiltonian of a (4p–4n) system in the $f_{\frac{7}{2}}$ shell was diagonalized using the quartet roton model. The spectra and wave functions of 0^+ were compared with those given by the shell model. (France)

18693 (JINR-P4-6781) PAIR CORRELATIONS AND COLLECTIVE 0^+ STATES IN NUCLEI WITH A ≈ 56. Dzholos, R. V.; Kartavenko, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 25p. (In Russian); Dep. NTIS (U. S. Sales Only).

The properties of the collective Hamiltonian of a nucleus constructed for describing the collective pair excitations are studied. The calculation of energies is performed, and the scheme of collective pair 0^+ states of nuclei with A ≈ 48 to 64 is constructed. A phenomenological account is taken of symmetry energy. A comparison is made with the experimental data on 2-nucleon-transfer reactions and on the nuclear binding energies. (9 figures) (auth)

18694 NUCLEAR SIZES IN CALCIUM ISOTOPES AND N = 28 ISOTONES. Lombardi, J. C. New Brunswick, NJ; Rutgers – The State Univ. (1972). 113p. University Microfilms Order No. 72-27,572.

Thesis.

There are various methods of determining nuclear sizes. In particular, optical-model analyses of proton scattering data can be used to determine the radii of distributions of nuclear matter. Differential cross-section and analyzing-power angular distributions were measured for protons elastically scattered from ^{40,44,48}Ca, ^{50}Ti, ^{51}V, ^{52}Cr and ^{54}Fe at energies in the range of 10.8 MeV to 16.3 MeV. The rms radii of the real-central potentials were determined from optical-model analyses of the angular distributions. With the exception of ^{40}Ca, the optical model gives a very good representation of the data. The rms radii of the real-central potentials, and the rms radii of the charge distributions were used to calculate the rms radii of the neutron distributions. From these analyses it was determined that the radii of the neutron and proton distributions are approximately the same in ^{40}Ca and ^{44}Ca, and that the radii of the neutron distributions are larger than the radii of the proton distributions in the N = 28 isotones. The radii of the matter distributions determined in these analyses are found to vary approximately as a constant times $A^{\frac{1}{3}}$, while the radii of the proton distributions determined from electron scattering are found to vary approximately as a constant times $Z^{\frac{1}{3}}$. The results in the calcium isotopes are compared to results determined from other investigations. Particle scattering results in ^{48}Ca indicate that the radius of the neutron distribution is larger than the radius of the proton distribution. Coulomb energy difference measurements yield a smaller difference in these radii than is indicated from particle scattering. (Diss. Abstr. Int., B)

18695 INVESTIGATION OF THE FLUCTUATIONS IN THE ^{40}Ca(n,p)^{40}K CROSS-SECTION BETWEEN 2.4 AND 2.9 MeV. Bartle, C. M. (Victoria Univ., Wellington, New Zealand). pp 178-88 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter: Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The cross section for the ^{40}Ca(n,p)^{40}K reaction was measured at E_n = 2.4 to 2.9 MeV. Neutrons were produced by the D(d,n) reaction and their energies were accurately determined by the associated particle technique. Fluctuations which had not previously been seen in the cross section were observed. (JWR)

18696 E2 TRANSITION STRENGTHS IN ^{46}Ca AND ^{44}Ca ISOTOPES FROM COULOMB EXCITATION MEASUREMENTS. Bini, M. (Univ., Florence); Bizzeti, P. G.; Bizzeti-Sona, A. M.; (and others). Lett. Nuovo Cim.; 5: No. 14, 913-17(2 Dec 1972).

Coulomb excitation by alpha inelastic scattering on ^{42,44,46}Ca was studied at 4.5, 4.75, and 5 MeV incident energies. The γ spectra were measured with a Ge(Li) detector. B(E2) values for the $2^+ \rightarrow 0^+$ transition in ^{44}Ca and ^{46}Ca were determined relative to the known B(E2) value for ^{42}Ca. (JWR)

18697 INVESTIGATION OF ANGULAR CORRELATION OF 122–14-keV CASCADE IN ^{57}Fe. Virabyan, B. M.; Durgar'yan, S. S.; Eganyan, I. L.; Maloyan, A. G.; Pyuskyulyan, K. I. (Inst. of Physics Research, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 2, 93-96(1972). (In Russian).

The spectrometer for γ-quanta cascade investigation by angular correlation technique is described. The function of angular correlation, $W(\theta) = 1 - (1.024 \pm 0.002)\ P_2(\cos\theta)$ of ^{57}Fe was the measured 122 to 14-keV cascade. The value of $\delta = -0.13$ was determined. This value corresponds to M1 + (1.7 ± 0.1)% E2 mixture in the transition of 122-keV cascade in ^{57}Fe. (auth)

18698 SHELL-MODEL ANALYSIS OF PAIRING EXCITATIONS IN THE REGION 52 ≤ A ≤ 60. Bes, D. R.; Maqueda, E. E.; Perazzo, R. P. J. (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Phys.; A199: No. 1, 193-217(1973).

A shell-model diagonalization of a T = 1 residual pairing interaction is performed in the vicinity of ^{56}Ni for $J^\pi = 0^+$ states. Energies and differential cross sections for two-body transfer processes are compared with experimental values and with the harmonic predictions. Special attention is paid to those reactions which are sensitive to the existence of a phase transition between normal and superconducting systems. Furthermore, it is shown that the assumption of a harmonic nonadiabatic addition phonon explains systematically a number of weak transitions. A list of spectroscopic amplitudes for relevant (and so far unreported) cross sections is included. (12 figures, 4 tables) (auth)

18699 STUDY OF ^{47}Ti WITH THE ^{45}Sc(^{3}He,p)^{47}Ti AND ^{45}Sc(^{3}He,pγ)^{47}Ti REACTIONS. Meyer-Schuetzmeister, L. (Ar-

gonne National Lab., IL); Smith, J. W.; Hardie, G.; (and others). Nucl. Phys.; A199: No. 3, 593-623(1973).

The $^{45}Sc(^3He,p)^{47}Ti$ reaction was studied at $E(^3He) = 17$ MeV by magnetic analysis with the Argonne split-pole spectrograph. The energy resolution was about 25 keV (fwhm). The excitation energies of 22 levels at excitations up to 7.5 MeV were determined, and the angular distributions associated with them were measured and analyzed in terms of two-nucleon transfer DWBA calculations. Angular distributions indicating orbital angular-momentum transfer $L_{np} = 0$ were observed for two states: the analog state at 7.346 MeV and the 3.223-MeV state which is assumed to be the antianalog. The decay of the ^{47}Ti levels was studied by measuring the $p-\gamma$ coincidences in the $^{45}Sc(^3He,p\gamma)$ reaction at $E(^3He) = 12$ and 17 MeV, and level and decay schemes were established on the basis of the results. In the discussion of the properties of the ^{47}Ti states, the results are compared with those obtained in one-nucleon transfer reactions, and all the data are compared with the results of calculations based on two different models for ^{47}Ti. Comparing the reaction data with theory allows identification of eleven ^{47}Ti states that have simple configurations and are reasonably well described by theory. However, in an examination of the γ-decay data to obtain a more stringent test of the current models, the models were found incapable of accounting for the γ decay of some of these simple states. In particular, the 1.548-MeV state, which seemed to have a large $(f_{7/2})^6(p_{3/2})$ component, was not well described by the Coriolis-coupling model. (auth)

18700 STUDY OF THE EXCITED STATES OF ^{57}Ni VIA THE (p,d) AND $(^3He,\alpha)$ REACTIONS AT 27.5 AND 37.7 MeV. Edwards, F. M.; Kraushaar, J. J.; Ridley, B. W. (Univ. of Colorado, Boulder). Nucl. Phys.; A199: No, 3, 463-80(1973).

The excited states of the ^{57}Ni nucleus were studied using the neutron pickup reactions $^{58}Ni(p,d)^{57}Ni$ and $^{58}Ni(^3He,\alpha)^{57}Ni$ at energies of 27.5 and 37.7 MeV, respectively. Recently reported levels at 2.45, 3.01, and 3.36 MeV were confirmed, and new levels are reported at 4.46, 4.71, 5.86, 8.24, and 8.79 MeV. Spectroscopic factors and l_n, J, and T assignments are made for most levels. Previously unreported $l_n = 0$ and 2 levels are discussed. (auth)

18701 HINDRANCE OF ANALOG TO ANTIANALOG M1 TRANSITION IN $1f_{\frac{7}{2}}$ SHELL NUCLEI. Bortignon, P. F.; Manfredi, V. R.; Ricci, R. A. (Univ., Padua). Lett. Nuovo Cim.; 5: No. 9, 675-9(28 Oct 1972).

It is well known that M1 gamma transitions from the analog state to the antianalog state are generally strong in the 2s1d shell, whereas they are considerably reduced in the $1f_{\frac{7}{2}}$ shell. Attention is directed to the reduction in the strength of the M1 transition from the analog to the antianalog state in ^{49}Sc. This reduction has been explained by assuming a collective state at 7.37 MeV. To test whether the properties of the collective state in ^{49}Sc are very sensitive to the choice of the effective interaction, a very simple spin- and charge-exchange force of delta function form was used. Eigenvalues and eigenvectors obtained are tabulated, and the calculated levels are compared with experimental ones. B(M1) values and log-ft values for ^{49}Ca beta decay are also given. (RWR)

18702 ZERO-RANGE DWBA AND FDSM IN SUB-COULOMB NEUTRON TRANSFER REACTIONS. Anni, R.; Ladiana, P.; Taffara, L. (Univ., Lecce, Italy). Lett. Nuovo Cim.; 5: No. 10, 723-6(4 Nov 1972).

To obtain better insight into the differences between the FDSM and DWBA, the reaction $^{40}Ca(^{14}N,^{13}N)^{41}Ca$ was analyzed. For this reaction the Coulomb barrier and the break-up process threshold are at about 40 MeV and 13 MeV, respectively. The angular distribution at 18 MeV (cm) and the integrated cross section for laboratory energies from 18 to 30 MeV are shown for the DWBA and FDSM. Comparison of zero- and finite-range DWBA curves shows that the finite-range effects change the energy behavior of the integrated cross section only slightly. On the other hand, there are indications that this is not so for the FDSM results, and that the introduction of form factors can change the results significantly. It is suggested that the predictions of FDSM and DWBA in the zero-range approximation (the only domain in which the conclusions of this paper are valid) are the same at energies below the threshold (apart from absolute value) and become generally different at energies above the threshold of the three-body breakup process. Comparison of the FDSM results with the experimental angular distribution shows that this model overestimates the contribution of the three-body breakup channel. In conclusion, the form factor approximation may depend strongly on the particular reaction model used. (RWR)

18703 TOTAL PAIR PRODUCTION CROSS SECTIONS FROM 1.120 TO 2.754 MeV. Henry, L. C.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 22, 2756-2759 (15 Nov 1972).

Relative pair cross sections $\sigma_p(E_\gamma,Z)$ were measured for energies 1.120, 1.172, 1.333, 1.560, 2.225, and 2.754 MeV and Z = 22, 29, 42, 48, 74, and 82. Results obtained through intensity analysis of annihilation spectra were normalized to $\sigma(2.754, 82) = 3.30$ b/atom. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 18227, 18239, 18670, 18674, 18691, 18693, 18703, 18719, 18757, 18816, 18845, 18852, and 18862.

18704 (COO-3122-3) PROTON ENHANCEMENT INDUCED BY ISOSPIN CONSERVATION IN THE LOW-ENERGY CONTINUUM: $p + {}^{62}Ni$, $\alpha + {}^{59}Co$. Jaffe, G. M. (Columbia Univ., New York). Jul 1972. 120p. Dep. NTIS.

Energy spectra measurements of emitted protons and alpha particles from the ^{63}Cu compound system excited to 18.06 MeV, formed from the reactions of protons with ^{62}Ni and alpha particles with ^{59}Co, indicate an apparent nonconformity to the Bohr Independence Hypothesis at the low-energy portion of the continuum. Protons emitted with energies above 4.6 MeV from the $p + {}^{62}Ni$ entrance channel exhibit spectral features inconsistent with a compound nuclear mechanism. The observed apparent violation of the Independence Hypothesis could not be explained by consideration of the angular-momentum disparities in the two entrance channels. The enhancement of low-energy protons, responsible for the apparent violation, could in fact be understood in the light of isotopic spin conservation. Inclusion of isospin theory in the angular-momentum-dependent statistical model is quantitatively in agreement with experimental measurements and is consistent with an isospin purity of 50%. (auth)

18705 (IFA-CRD-50) CALCULATIONS OF NEUTRON SCATTERING CROSS-SECTIONS ON ^{60}Ni. Berinde, A.; Duma, M.; Dumitru, R. O.; Scintei, N.; Teodorescu, C. M.; Vladuca, G.; Zoran, V. (Institutul De Fizica Atomica, Bucharest (Romania)). 1972. 16p. Dep. NTIS (U. S. Sales Only).

Differential and integrated cross sections for neutron elastic scattering and inelastic scattering to the first excited state of ^{60}Ni were calculated from 2 to 8.5 MeV in about 1-MeV steps. The cross sections were computed by using the optical model for the elastic scattering, the statistical theory for the compound processes, and the DWBA theory for the direct inelastic scattering. The optical-model parameters of Wilmore and Hodgson were used. The combined predictions of Hauser-Feshbach-Moldauer, optical-model, and DWBA calculations are in good agreement with available experimental data. (3 figures, 3 tables) (auth)

18706 EXPERIMENTAL AND THEORETICAL STUDY OF PARTICLE-CORE COUPLING IN ^{63}Cu. Markham, R. G. Rochester, NY; Univ. of Rochester (1972). 145p. University Microfilms Order No. 72-28,774.

Thesis.

The two neutron pickup reaction $^{65}Cu(p,t)^{63}Cu$ has been studied with 18.0 and 19.5 MeV protons. Twelve angular distributions were obtained for states below 2.54 MeV, in the range 3 to 45°. Zero-range, local DWBA calculations were carried out for the two-nucleon transfer. The angular distributions to the state at 1.547 MeV and to a group of states at 2.5 MeV clearly indicated L = 0 (along with L = 2) pickup; thus the state at 1.547 MeV and, tentatively, the state at 2.495 MeV have been assigned $J^\pi = 3/2^-$. The observed relative L = 2 cross sections were compared with structure factors predicted by the calculations, one based on shell model wave functions for ^{63}Cu and ^{65}Cu, the other on particle-core wave functions for $^{63,65}Cu$, the shell model being used in this case to describe the microscopic structure of the nickel core nuclei. Neither prediction agreed with the data. However, the experimental results could be reproduced by a calculation in which particle-core wave functions were used and the structure factors for the $^{64}Ni(p,t)^{62}Ni$ reaction were varied to fit the data. Thus the particle-core model appears to be consistent with the data. The structure factors computed from the shell model are too sensitive to the two-body interaction to give reliable results. By examining the radiation following the decay of ^{63}Zn to ^{63}Cu, branching ratios have been found for gamma ray transitions between the low-lying states of ^{63}Cu. Reduced M1 transition probabilities derived from these results and from lifetimes recently measured are compared with predictions of the particle-core coupling model. Evidence is found that 1^+ core excitations play an important role in determining M1 transition probabilities. Effective M1 single-particle matrix elements are derived from the data. The theory of particle-core coupling is discussed in terms of the shell model. It is shown that the two models are equivalent, differing only when approxima-

tions are made. The origin and nature of various multipole sum rules are discussed in the context of the particle-core coupling model. Several useful sum rules are written out in detailed form. These rules involve: sums over all initial (final) states, with spin j, of reduced transition rates to a given final (initial) state; sums over all initial and final states of spin j and k; and sums of electrostatic or magnetic moments over all states of the same spin. An approximate two-neutron-transfer sum rule is proposed. Applications are explored in general terms. A detailed particle-core model calculation is performed for ^{63}Cu, and the sum rules are applied. Detailed comparisons with experiments are made for energy levels, proton stripping strengths, and electro-magnetic transition strengths. A significant improvement over previous calculations is obtained by use of realistic core matrix elements for the particle-core interaction. An upper limit of 2.0 can be set for the effective proton charge, but use of the bare proton charge of 1.0 is seen to be reasonable. (Diss. Abstr. Int., B)

18707 CONCERNING THE DECAY OF 2.6 h ^{65}Ni. Paradellis, T.; Katsanos, A. A. (Democritus Nuclear Research Center, Athens). Can. J. Phys.; 50: No. 21, 2728-2734(1 Nov 1972).

The decay of ^{65}Ni was investigated using Ge(Li) and NaI(Tl) detectors. The results support the existence of the following states in ^{65}Cu with corresponding spin and parity assignments: 0($\frac{5}{2}^+$), 770.7($\frac{1}{2}^-$), 1115.5($\frac{5}{2}^-$), 1481.9($\frac{7}{2}^-$), 1623.5($\frac{5}{2}^-$), and 1725.0($\frac{3}{2}^-$) keV. (auth)

18708 LEVELS IN ^{89}Rb POPULATED BY THE BETA DECAY OF ^{89}Kr. Poehlman, W. F. S.; Singh, B.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 22, 2741-2752(15 Nov 1972).

The decay of 3.2 min ^{89}Kr was investigated with small and large volume Ge(Li) detectors used singly and in a dual parameter coincidence arrangement. A total of 162 gamma rays are identified with the decay of this isotope, 120 of which are placed in a level scheme on the basis of gamma–gamma coincidence evidence and the energy differences between established levels. Levels at 220.9, 497.7, 577.3, 586.1, 930.7, 931.5, 997.6, 1195.5, 1324.6, 1530.1, 1533.6, 1694.1, 1822.1, 1998.9, 2160.5, 2401.5, 2598.5, 2867.2, 3099.7, 3329.9, 3363.1, 3372.1, 3534.1, 3719.3, 4145.1, 4217.4, 4340.9, and 4487.5 keV are well established by coincidence data and many energy sums. The levels proposed at 2783.4, 3429.7, 3456.6, 3978.4, 4058.4, and 4406.5 keV are less securely established. The most probable spins of the ground state and the first two excited states are $\frac{3}{2}^-$, $\frac{5}{2}^-$, $\frac{1}{2}^-$ respectively. Improved energies and intensities of the gamma rays from the decay of 15 min ^{89}Rb were also determined. (auth)

18709 STUDY OF THE PARTICLE–VIBRATION COUPLING IN ODD COPPER ISOTOPES WITH TWO-NEUTRON TRANSFER REACTIONS. Iwasaki, Y. (Shizuoka Univ., Japan); Sekiguchi, M.; Soga, F.; Takahashi, N. Phys. Rev. Lett.; 29: No. 22, 1528-30(27 Nov 1972).

It is suggested on experimental grounds that the phonon components of particle-vibration coupled states in proton-odd nuclei can be studied with two-neutron transfer reactions. The case of low-lying excited states in odd copper isotopes is discussed. Some evidence is found for a change in the particle-vibration coupling in going from ^{61}Cu to ^{63}Cu. (auth)

18710 IDENTIFICATION OF NEW GERMANIUM ISOTOPES IN FISSION: DECAY PROPERTIES AND NUCLEAR CHARGE DISTRIBUTION IN THE A = 78 TO 84 MASS REGION. Del Marmol, P.; Fettweis, P. (CEN/SCK, Mol, Belgium). Nucl. Phys.; A194: No. 1, 140-60(1972).

By means of a fast radiochemical separation, germanium was isolated at short time intervals from ^{235}U irradiated with thermal neutrons. By extrapolating γ- or β-activities of known descendants, the half-lives of the following isotopes were determined, several of these being unreported previously: ^{78}Ga: 4.8 ± 1.3 s, ^{78}Ge: 41.1 ± 4.3 s, ^{80}Ge: 24.5 ± 1.0 s, ^{81}Ge: 10.1 ± 0.8 s, ^{82}Ge: 4.60 ± 0.35 s, ^{83}Ge: 1.9 ± 0.4 s, ^{84}Ge: 1.2 ± 0.3 s. It is shown that ^{82}Ge decays only to the low-spin isomer of ^{82}As whose half-life was redetermined as 22.6 ± 1.4 s. The main γ-ray energies and intensities were measured for the longer-lived isotopes and partial schemes are given for the decay of ^{81}Ge, ^{81}As, and ^{82}As. From the relative fission-yield measurements, nuclear-charge distribution is discussed for this mass region. (auth)

18711 ENERGIES AND INTENSITIES OF γ RAYS IN THE DECAY OF ^{79}Sr. Ladenbauer-Bellis, I. M.; Bakhru, H.; Jones, B. (Yale Univ., New Haven). Can. J. Phys.; 50: No. 23, 3071-3072 (1 Dec 1972).

The decay of ^{79}Sr was studied using high resolution Ge(Li) detectors. ^{79}Sr was produced via the ^{69}Ga(^{14}N,4n) reaction. The half-life of 4.4 ± 0.2 min was assigned to ^{79}Sr. A gamma ray of 105.4 ± 0.2 keV was assigned to the decay of ^{79}Sr. (auth)

18712 STATES OF ^{74}Se OBSERVED FOLLOWING THE DECAY OF ^{74}Br. Coban, A.; Lisle, J. C.; Murray, G.; Willmott, J. C. (Univ. of Manchester, Eng.). Particles Nucl.; 4: No. 2-3, 108-25 (1972).

The energy levels of ^{74}Se were studied by observing the γ rays following the decay of ^{74}Br. A number of new levels were located, and the existence of states at 853.8 keV and 1269.1 keV was confirmed. Angular correlation measurements led to spin assignments of 0 and 2, respectively, for these two states, and additional spin and parity assignments were made from log-ft values and the modes of decay of the states. Evidence is presented which indicates that ^{74}Br possesses a $J^\pi = 4^-$ ground state. The collective interpretation of some of the lower states of ^{74}Se is discussed. (4 figures, 4 tables) (auth)

18713 ANGULAR MOMENTUM EFFECTS IN ^{59}Co(α,n) REACTION. Alevra, A.; Duma, M.; Dumitrescu, R.; (and others) (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 10, 1187-1190(1972).

Angular distributions of neutrons resulting from the ^{59}Co(α,n) reaction at E_α = 16.6 MeV were measured for several intervals of excitation energy in the residual nucleus (4 to 8 MeV). The results were interpreted in the frame of the statistical model and a value of 0.4 to 0.5 J_{rigid} was obtained for the moment of inertia. The spin cut-off factor was determined too. (auth)

18714 NON-STATISTICAL EFFECTS IN (n,γ) REACTIONS. Kardon, Bela (Central Research Inst. for Physics, Budapest). Fiz. Szemle; 22: No. 10, 301-303(Oct 1972). (In Hungarian)

Recent results on γ radiation following the capture of thermal and resonance neutrons are reviewed, presenting also a theoretical interpretation of the experimental data. The structure of these γ spectra reflects that of the involved nuclei. As the mass number increases, the spectra become increasingly complex. Lines with good resolution are encountered in both the high- and the low-energy ranges of the spectra; they are connected by a continuous spectrum. The γ spectrum emitted during decay after neutron capture may be derived on the basis of Bohr's compound nucleus: the intermediate nucleus created after neutron capture by γ radiation decays in the statistically permitted channels. This statistical concept and the direct reaction process are outlined. Analysis of the resonances indicates unequivocally a direct reaction only in the cases of ^{59}Co(n,γ)^{60}Co and ^{238}U(n,γ)^{239}U reactions. The importance of the correlation coefficient which relates the radiation width and the reduced neutron width to each other, and the doorway mechanism are pointed out, using the ^{163}Dy(n,γ)^{164}Dy reaction as an example. (TTT)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 17111, 17306, 18239, 18691, 18757, 18764, 18789, 18815, 18816, 18845, and 18863.

18715 (AD–746330) EXPERIMENTS WITH ENERGETIC HEAVY IONS. Final Report, March 1, 1971–February 29, 1972. Davis, R. H.; Heydenburg, N. P. (Florida State Univ., Tallahassee. Dept. of Physics). May 1972. 88p. (AFOSR-TR–72-1319). NTIS.

Research on heavy-ion physics is discussed. Reaction mechanisms studies, searches for new unstable residual nuclei, and transfer reaction experiments were undertaken to characterize the collisions of heavy ions in terms of bombarding energy, structure of the collision partners, and processes leading to new and unusual isotopes. There is some evidence that fission-like processes occur even in relatively light but highly excited nuclear systems. The results of heavy-ion experiments test models for compound nuclei at high excitation and reaction mechanisms yielding products far from the valley of stability. Progress is reported on the construction of a quadrupole spectrometer which will be used for heavy ion research and on the feasibility of a very heavy, very highly ionized positive-ion source. The investigation includes precise Q-value and threshold measurements, isobaric analog state studies, and nucleon-transfer studies for light projectiles. (auth)

18716 (CONF-730302–1) COMPILATION OF MODERN NUCLEAR DECAY DATA FOR HIGH RESOLUTION GAMMA SPECTROSCOPY. Dyer, F. F.; Bate, L. C. (Oak Ridge National Lab., Tenn.). 1972. 8p. (SM–170/44). Dep. NTIS.

Recently published radionuclide decay data necessary for interpreting and quantifying high-resolution gamma spectra were collected and tabulated. The data, consisting of gamma energies and intensities and other information, e.g., half-lives, fission yields,

neutron cross section, etc., for over 500 radionuclides, were computer processed to yield a tabular form highly useful to gamma spectroscopists and activation analysts. The collection is unique in that many short-lived radionuclides, e.g., fission gases, are included that are not found in similar data tables. Basically, two computer listings are produced. The first table lists all data for each radioisotope arranged according to increasing atomic number (with increasing mass number for isotopes of the same atomic number). The source of reference for each nuclide is documented. The second table consists of a list of sorted gamma energies arranged according to increasing energy. Opposite each gamma energy is the contributing radionuclide symbol, its mass number and half-life, a classification of nuclide type (e.g., fission product), several associated gamma energies and their intensities, and a cross reference to the entry in Table I. By careful attention to the elimination of nonprominent gamma rays Table II is kept manageably small yet sufficiently complete to permit spectroscopists to identify rapidly the lines of gamma spectra and/or check the results of spectral analysis codes. The data on magnetic tape along with a program to make listings are available to users on request to the ORNL Radiation Shielding Information Center. The organization of the tables, applications of the data to gamma spectral studies of reactor components and activation analysis, and additional data needs are discussed. (auth)

18717 (IS-T-549) DECAYS OF ^{138}Xe AND ^{138}Cs. Carlson, G. H. (Ames Lab., Iowa). Nov 1972. Contract W-7405-eng-82. 126p. Dep. NTIS.

Thesis.

The beta and subsequent gamma decays of ^{138}Xe and ^{138}Cs were investigated using the on-line isotope separator system TRISTAN at the Ames Laboratory Research Reactor. Ge(Li) gamma-ray singles and Ge(Li)–Ge(Li) gamma–gamma coincidence measurements were used to construct level schemes for the ^{138}Cs and ^{138}Ba nuclei. Of the 98 gamma-ray transitions observed in the decay of ^{138}Xe, 94 were placed in a level scheme for ^{138}Cs with 27 excited states. Of the 86 gamma rays attributed to the decay of ^{138}Cs, 82 were placed in a level scheme for ^{138}Ba with 36 excited states. Ge(Li)–plastic coincidence measurements were used to determine the Q values for each decay. The Q values for the ^{138}Xe and ^{138}Cs decays were found to be 2.83 ± 0.08 MeV and 5.28 ± 0.07 MeV, respectively. Spin and parity assignments were made by using gamma-ray transition probabilities, log-ft values calculated from the gamma-ray transition intensities, and other information existing in the literature. Interpretation of some of the energy levels is made from a shell-model viewpoint. (auth)

18718 (RT/FI-(72)42) CODE UNREC FOR THE CALCULATION OF EFFECTIVE CROSS SECTIONS AND THE RESONANCE INTEGRALS IN THE UNRESOLVED RESONANCE REGION. Lesca, L.; Menapace, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 3 Oct 1972. 34p. (In Italian). Dep. NTIS (U. S. Sales Only).

The UNREC code calculates both group cross sections and resonance integrals in the unresolved resonance region as a function of the temperature (Doppler effect) and the dilution of the considered isotope in a given homogeneous mixture. Theory and the adopted approximations are discussed, and some significant applications are presented. (3 figures, 3 tables) (auth)

18719 REACTION LIST FOR CHARGED-PARTICLE-INDUCED NUCLEAR REACTIONS Z = 1 TO Z = 99 (H TO Es) JULY 1971–JUNE 1972. McGowan, F. K.; Milner, W. T. (Oak Ridge National Lab., TN). Nucl. Data, Sect. A; 11: No. 1, 1-126(1972).

This Reaction List for charged-particle-induced nuclear reactions has been prepared from the journal literature for the period from July 1971 through June 1972. Each published experimental paper is listed under the target nucleus in the nuclear reaction with a brief statement of the type of data in the paper. The nuclear reaction is denoted by A(a,b)B, where $M_a \geq$ (one nucleon mass). There is no restriction on energy. Nuclear reactions involving mesons in the outgoing channel are not included. Theoretical papers which treat directly with the analysis of nuclear reaction data and results are included in the Reaction List. (auth)

18720 STUDY OF THE NUCLEUS ^{107}Ag IN THE CORE-EXCITATION MODEL VIA THE (p,t) AND (^{3}He,d) REACTIONS. Kuhfeld, A. W. Minneapolis; Univ. of Minnesota (1972). 176p. University Microfilms Order No. 72-27,768.

Thesis.

The states of the ^{107}Ag residual nucleus were examined via the (p,t) and (^{3}He,d) reactions. Unambiguous L,J$^\pi$ determinations were found for fine levels: L = 0, J$^\pi$ = $\frac{1}{2}^-$ at 1.615, 1.653, and 1.854 MeV; L = 3, J$^\pi$ = $\frac{5}{2}^+$ at 2.030 MeV; and L = 3, J$^\pi$ = $\frac{7}{2}^+$ at 1.653 MeV. The L = 3 strength in ^{109}Ag(p,t) ^{107}Ag (summed from approximately 10 levels) was equal within 15% to the L = 3 strength in ^{108}Pd(p,t) to the 2.084 MeV level of ^{106}Pd. The 2.182 and 2.203 MeV levels of ^{107}Ag accounted for approximately half this strength. It is suggested that (to a first approximation) these two levels are respectively the $\frac{7}{2}^+$ and $\frac{5}{2}^+$ members of the core-excitation doublet built upon the octupole vibration of ^{106}Pd. No evidence was found for states of ^{107}Ag built upon the two-quadrupole-phonon 0$^+$ and 4$^+$ excitations of the neighboring even nuclei. Wavefunctions were hypothesized for the $\frac{1}{2}$-ground state, the $\frac{3}{2}^-$ states of 0.325 and 0.787 MeV, and the $\frac{5}{2}^-$ states at 0.423 and 0.950 MeV. These wavefunctions mixed the ground 0$^+$ and one- and two-quadrupole-phonon 2$^+$ states of ^{106}Pd with the 2p $\frac{1}{2}$, 2p $\frac{3}{2}$, and 1f $\frac{5}{2}$ single-proton-hole states. Admixture coefficients were determined by fitting the known electromagnetic moments and transitions for ^{107}Ag. These wavefunctions (combined with differential cross sections from ^{108}Pd(p,t)^{108}Pd) were used to predict the (p,t) cross sections to the $\frac{3}{2}^-$ and $\frac{5}{2}^-$ levels of ^{107}Ag with much greater accuracy than the simple core-excitation wavefunctions. The angular distribution for a given L-transfer in (p,t) to odd-Z ^{107}Ag appeared to depend upon the J of the final state. Ground-state strengths were measured for (p,t) from all stable isotopes of Ag and Pd except ^{102}Pd. These strengths were found to lie on a smooth curve for the even-N parent nuclei; the strength from odd-N ^{105}Pd was approximately half the average for the neighboring even-N nuclei. The ground-state Q-value for ^{107}Ag(p,t)^{105}Ag was −8.994 ± 0.005 MeV. (Diss. Abstr. Int., B)

18721 NUCLEAR REACTION SPECTROSCOPY WITH EVEN MASS Ce TARGETS. Mulligan, T. J. Tallahassee; Florida State Univ. (1972). 153p. University Microfilms Order No. 72-23,099.

Thesis.

The (t,p) reaction on ^{138,140}Ce at 15 MeV incident energy and the (p,t) process on ^{142}Ce at 21.5 MeV have been studied. The (t,d) reaction on ^{138}Ce and the ^{142}Ce(p,d) process were measured simultaneously with the respective (t,p) and (p,t) reactions. Differential cross sections were measured between 12 and 72° and L = 0 and 2 and -value assignments were made. Less extensive data on ^{136,142}Ce(t,p), ^{140}Ce(p,t), and ^{140}Ce(p,d) were also acquired and a ^{140}Ce(t,t) angular distribution was obtained at 15 MeV. The strongest L = 0 and L = 2 transitions are discussed in relation to the pairing vibration model; in particular the 3226 keV state in ^{140}Ce is identified as the (1,1) phonon state and several candidates for pairing quadrupole vibration states are noted. Spectroscopic factors are derived for the levels populated in the single neutron transfer reactions, and these are compared with model expectations. The results of the analyses of the two-neutron and one-neutron transfer reactions are finally combined and are seen to present a consistent description of the nuclear spectroscopy of this region. (Diss. Abstr. Int., B)

18722 NEW ISOTOPE OF TIN. Rivier, Janine; Moret, Roger (Univ., Grenoble, France). Compt. Rend., Ser. B; 275: No. 15, 565-7(9 Oct 1972). (In French).

The ^{106}Cd(α,3n) reaction revealed the existence of ^{107}Sn. Its half-life is 1.3 ± 0.3 mn. (auth)

18723 INTERACTION OF THERMAL NEUTRONS WITH CADMIUM ISOTOPES. Vertebnyi, V. P.; Vlasov, M. F.; Gnidak, N. L.; (and others) (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 1, 38-44(Jan 1972). (In Russian).

^{111,112,114,116}Cd neutron total and scattering cross-section energy dependences were measured. The samples were irradiated with the 4.3×10^{20} neutron/cm^2 neutron flux in a reactor core to burn up ^{113}Cd impurities. The measurements were performed by using the neutron chopper with 6 μsec/m resolution. The scattering cross sections were measured in 4π-geometry on the thin samples in the 0.3 to 9 eV energy range. After the irradiation the ^{113}Cd resonance (0.178 eV) did not occur in the transmission curves. The neutron capture cross section at 2200 m/sec was estimated for ^{112}Cd ≤ 0.5 and ^{116}Cd ≤ 2.5 barn. This was obtained for ^{111}Cd 7.7 ± 0.8 barn and ^{114}Cd 6.9 ± 0.7 barn. The scattering cross sections σ_s for ^{111,112,114,116}Cd and natural Cd are 5.2 ± 0.3; 6.9 ± 0.3; 5.2 ± 0.3; 6.4 ± 0.3 and 5.6 ± 0.3, respectively. For energies lower than 0.03 eV, the total cross sections have a λ^2 component, probably due to the neutron small angle scattering by the grains. The method enables one to estimate $\sim 5 \times 10^{-3}$% of ^{113}Cd impurities in the samples. This value is comparable with the mass-spectrographic analysis sensitivity. (auth)

18724 MEAN L-SHELL X-RAY FLUORESCENCE YIELDS AT Z = 47, 60, AND 63. Nix, D. W.; McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Z. Phys.; 256: No. 2, 131-7(1972).

Mean L-shell x-ray fluorescence yields ($\bar{\omega}_L$) have been measured by observing K and L x-ray spectra emitted in the decay of ^{109}Cd, ^{145}Pm, and ^{153}Gd with a high resolution Si(Li) x-ray detector. The results for Z = 47, 60, and 63 are as follows: $\bar{\omega}_L$ = 0.0425 ± 0.0064, 0.131 ± 0.017, and 0.142 ± 0.023, respec-

tively. Additional values of $\bar{\omega}_L$ from this laboratory at Z = 55, 56, 57, 59, and 65 are also tabulated as are previous experimental values at Z = 47, 60, and 63. For comparison, theoretical estimates of $\bar{\omega}_L$ were computed using theoretical L-subshell fluorescence and Coster-Kronig yields, together with subshell vacancy distributions calculated from the literature. The theoretical estimates at Z = 47, 60, and 63, based on the subshell calculations of Chen, Crasemann, and Kostroun, agree well with experiment. (auth)

18725 MICROSCOPIC CALCULATION FOR PROTON INELASTIC SCATTERING FROM COLLECTIVE LEVELS IN THE TIN ISOTOPES. Terrien, Y. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A199: No. 1, 65-80(1973).

Microscopic calculations of the (p,p′) cross sections of the low-lying 2^+ and 3^- collective levels in the tin isotopes are presented. A nucleon–nucleon force and RPA wave functions are used. The proton and neutron transition densities are renormalized in such a way that calculated values of both (p,p′) cross sections and electromagnetic reduced matrix elements B(EJ) are in good agreement with the experimental ones. Then the proton and neutron transition densities "truly" existing in the nucleus are compared. A comparison with the effective-charge method is also given. (4 figures, 6 tables) (auth)

18726 COMPARISON OF SUB-COULOMB STRIPPING AND ANALOG RESONANCE RESULTS IN ^{93}Zr. Kent, J. J.; Morgan, J. F.; Seyler, R. G. (Ohio State Univ., Columbus). Nucl. Phys.; A197: No. 1, 177-84(1972).

The ^{92}Zr(d,p)^{93}Zr reaction leading to states in ^{93}Zr which are parents of analog states observed in ^{92}Zr(p,p) elastic scattering was studied for incident deuteron energies below the Coulomb barrier. For each of the parent states the reduced normalization was extracted, and these were compared with the reduced normalizations calculated for the analog resonances on the basis of various analog resonance theories. (auth)

18727 VOLUME FORM OF COUPLING INTERACTION IN SEMI-DIRECT (n,γ) AND (p,γ) REACTIONS. Longo, G.; Saporetti, F. (CNEN, Bologna). Nucl. Phys.; A199: No. 3, 530-44(1973).

A coupling interaction between the nucleon and the nuclear E1 mode having a volume radial form instead of the usual surface one is used in the semidirect nucleon radiative-capture theory. The calculated cross sections for the ^{208}Pb(n,γ) and ^{142}Ce(p,γ) reactions in the giant-resonance region reproduce the measured ones both in shape and magnitude. Satisfactory agreement is achieved in comparing the predicted and detected γ-ray spectra following neutron capture by ^{208}Pb. A detailed analysis of the energy and angular-momentum dependence of the matrix elements when the volume and surface form factors are used is performed. (auth)

18728 EVIDENCE OF M1 AND E2 STRENGTH IN THE GIANT RESONANCE REGION OF Ce. Pitthan, R.; Walcher, Th. (Technische Hochschule, Darmstadt, Ger.). Z. Naturforsch.; 27a: No. 11, 1683-4(Nov 1972).

Inelastic electron scattering from Ce (50 and 65 MeV, 93°, 129°, and 165°) had shown evidence for an M1 and E2 resonance at 8.7 and 12.0 MeV, respectively. These assignments have been confirmed by DWBA calculations. Reduced transition probabilities are derived for the above resonances and for the giant E1 resonance. (1 figure, 1 table) (auth)

18729 MEASUREMENT OF THE LIFETIMES OF ^{135}La AND ^{133}La EXCITED STATES. Berg, V.; Letessier, J.; Bourgeois, C.; Foucher, R. (Paris Univ., Orsay, France). J. Phys. (Paris); 33: No. 10, 829-834(Oct 1972). (In French).

The half-lives of the 119.4-keV and 206.4-keV levels of ^{135}La were measured in the framework of a systematic study of transition nuclei. They were found to be 3.9 ± 0.1 and 0.48 ± 0.03 ns, respectively. The limiting values of the lifetimes of the 265.3-keV and the 299.8-keV levels of ^{135}La (<0.12 ns) and of the 97.2-keV level of the ^{133}La(<0.10 ns) were obtained. The measurements were made using delayed e–γ and e–e coincidences, the electrons being selected with a double lens Gerholm spectrometer. The partial transition probabilities calculated from the measurements are compared with theoretical predictions, in particular those of a unified model with intermediate coupling between a single odd particle and the vibrations of the core surface. (France)

18730 LIFETIMES OF EXCITED STATES OF SOME ODD ISOTOPES OF Tc, Ru, Pd, AND Sb NUCLEI. Begzhanov, R. B.; Gladyshev, D. A.; Azimov, K. Sh.; Mukhammadiev, A.; Narzykulov, M. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 1, 24-25(1972). (In Russian).

New data are advanced on the half-lives of the excited states (in ps) of the nuclei ^{97}Tc, ^{99}Ru, ^{101}Ru, ^{103}Pd, ^{105}Pd, and ^{125}Sb. These nuclei were obtained from ^{97}Ru, ^{99,101}Rh, ^{101}Tc, ^{103,105}Ag, and ^{125}Sn by using (n,γ), (p,γ), and (p,n) reactions in a nuclear reactor or a cyclotron. (1 table) (KSW)

18731 AVERAGE RESONANCE SPECTROSCOPY IN $^{93\ 95\ 97}$Tc. Close, D. A.; Bearse, R. C. (Univ. of Kansas, Lawrence). Nucl. Phys.; A201: No. 2, 337-356(1973).

The (p,γ) reactions on the ^{92}Mo, ^{94}Mo and ^{96}Mo isotopes were studied in the energy range E_p = 2.4 to 3.0 MeV using a Ge(Li) detector incorporated into a three-crystal pair spectrometer and a Ge(Li) detector in coincidence with a NaI(Tl) detector. A three-crystal pair spectrometer was utilized to determine the average yield of γ-rays leading directly to the low-lying states in each of the three residual nuclei. These average yields were examined for a possible correlation between the intensity of high energy γ-ray transitions and the J^π of the final state. The data indicate that such a correlation exists. A two-dimensional coincidence experiment determined the decay scheme of the low-lying excited states in ^{93}Tc, ^{95}Tc and ^{97}Tc. The J^π assignments inferred from these experiments are consistent with those for the states in ^{93}Tc, ^{95}Tc and ^{97}Tc which have previously been obtained. For those states which were previously unassigned the results of this experiment are as follows (all energies are in keV): ^{93}Tc–680 ($7/2^+$), 1193 ($5/2^+$), 1406 ($1/2^-$, $3/2^-$), 1555 ($1/2^-$, $3/2^-$), 2429 ($\leq 5/2$); ^{95}Tc–1278 ($3/2^+$), 1619 ($3/2^+$, $5/2^-$), 2556 ($\geq 5/2$); ^{97}Tc–948 ($1/2^-$, $3/2^-$), 1060 ($5/2^+$, $7/2^+$), 1138 ($5/2^\pm$), 1366 ($3/2^+$), 1387 ($3/2^+$, $5/2^\pm$), 1517 ($1/2^-$, $3/2^-$), 1573 ($3/2^+$, $5/2^\pm$), 1676 ($3/2^+$, $5/2^\pm$). The state at 2429 keV in ^{93}Tc has not been reported previously. (auth)

18732 OPTICAL ORIENTATION OF 6.7-h ^{107}Cd. Spence, P. W.; McDermott, M. N. (Univ. of Washington, Seattle). Phys. Lett.; 42A: No. 4, 273-4(18 Dec 1972).

Nuclear orientation of 6.7-h ^{107}Cd was achieved by optical pumping with 3261 Å cadmium resonance radiation. The ratio of the nuclear resonance frequency of ^{107}Cd to that of stable ^{111}Cd in the same sample cell is $\nu(^{107}\text{Cd})/\nu(^{111}\text{Cd})$ = 0.206 780 9 (2). (auth)

18733 USE OF DECAY PROTONS TO STUDY THE $^{94\ 95\ 96}$Mo(p,n) CHARGE EXCHANGE REACTION. Whitten, C. A. Jr.; Dunlop, W. H.; Grover, S.N.; (and others) (Univ. of California, Los Angeles). Lett. Nuovo Cim.; 5: No. 17, 1093-8 (23 Dec 1972).

The derivation of an equation relating the decay proton energy distribution to the angular distribution for the (p,n) charge-exchange reaction is first discussed. Experimental data for the (p,np) reaction at 20.0 to 30.3 MeV with ^{94,95,96}Mo are then presented, along with a formula which indicates that the broadening of the decay proton ($\tilde{p}$) energy structure due to the recoil of the isobaric analog of the target ground state (IAS_g) can, in principle, determine $\langle\cos^2\theta_n\rangle$ for the angular distribution of the (p,n) charge-exchange reaction. Typical spectra and the angular dependence of the mean $\tilde{p}$ energy are shown. $\langle E_{\tilde{p}}(\theta)\rangle$ is found to vary linearly with cos θ. Mean values for cos θ_n and the laboratory momentum of the recoiling IAS_{gs} are tabulated. The shapes of the $(p,n)_{IAS}$ angular distributions are found to be approximately the same for all three isotopes. Finally, it is shown that the energy envelope of the $\tilde{p}$ group can, in principle, also determine the $\langle\cos^2\theta_n\rangle$ moment of the $(p,n)_{IAS}$ angular distribution. Results are compared with experimental data of other authors where available. (RWR)

18734 DECAY OF ^{138}La. Grench, H. A. (Lockheed Palo Alto Research Lab., CA). Particles Nucl.; 4: No. 2-3, 143-6 (1972).

The energies and relative intensities of the γ rays emitted in the decay of ^{138}La were carefully determined in order to resolve discrepancies between the results of previous work. The energies which were found are 789.0 ± 0.3 and 1436.0 ± 0.3 keV, and the ratio of the γ-ray intensities is I(789.0)/I(1436.0) = 0.53 ± 0.06. (1 table) (auth)

18735 NUCLEAR STRUCTURE STUDIES IN THE Z = 50 REGION. Baranger, E. U. (Massachusetts Inst. of Tech., Cambridge). Advan. Nucl. Phys.; 4: 261-314(1971). Contract AT(30-1)-2098).

Consideration is restricted to the odd- and even-mass tin isotopes and the odd-mass antimony and indium isotopes. In order to understand the experimental results, it is necessary to know the shell-model description of these nuclei and for this reason a brief discussion of it is given. Experimental observations are surveyed. Types of data which are available are listed, a discussion of what each reveals about the structure is given, examples are shown, and facts which remain unexplained are pointed out. The successes and failures of the theoretical calculations are pointed out. This is restricted to shell-model calculations which use realistic residual interactions, i.e., interactions which fit the free nucleon-nucleon scattering data. Calculations which use more phenomenological approaches are not discussed. (WDM)

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Refer also to abstracts 18239, 18714, 18718, 18719, 18757, 18816, 18845, and 18849.

18736 (CONF-720668-1) LEVELS IN ODD Dy NUCLEI STUDIED BY (^{3}He,α) REACTIONS. Thorsteinsen, T. F.; Grotdal, T.; Nyboe, K.; Straume, O. (Bergen Univ. (Norway). Dept. of Physics). Jun 1972. 12p. (In Norwegian). Dep. NTIS (U. S. Sales Only).

From Norwegian Physical Society's Annual Meeting; Tromso, Norway (26 Jun 1972).

The odd (and one of the even) Dy isotopes were examined with the ^{3}He,α) reaction. The bombarding energy was 25.5 MeV and the α-particles were photographically registered in the single-gap spectrograph at the Niels Bohr Institute's Tandem Accelerator at Risoe. All spectra were taken at 40°. The spectra show that the (^{3}He,α) reaction is selective, only a few peaks standing distinctly above the background. Spin conditions and energy levels were deduced. (Norway)

18737 (COO-3122-2) FISSIONABILITY AS A FUNCTION OF ANGULAR MOMENTUM FOR ^{170}Yb COMPOUND NUCLEI EXCITED TO 107 MeV. Zebelman, A. M. (Columbia Univ., New York). Jul 1972. 92p. Dep. NTIS.

Fission and complete fusion cross-sections are presented for four entrance channels leading to ^{170}Yb compound nuclei excited to 107 MeV: ^{11}B + ^{159}Tb, ^{12}C + ^{158}Gd, ^{16}O + ^{154}Sm, and ^{20}Ne + ^{150}Nd. Using the Bohr Independence Hypothesis, the data are combined to yield an experimentally determined dependence of fission probability on angular momentum for the systems studied. The results are compared to theoretical fissionability calculations based on the Bohr-Wheeler formalism for fission widths and the Weidkopf formalism for neutron and charged particle widths. The calculations include the effects of multiple chance fission. The agreement found between theory and experiment using a reasonable set of parameters tends to justify the use of the liquid-drop model in the description of fissionability's dependence on angular momentum. (auth)

18738 (JINR-E4-6873) CHANGE OF QUADRUPOLE MOMENTS DUE TO ROTATION CALCULATED WITH RESIDUAL ph AND pp INTERACTIONS. Meyer, J.; Speth, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 15p. Dep. NTIS (U. S. Sales Only).

The changes of charge and mass quadrupole moments $\delta\langle Q\rangle$ due to rotation are calculated for even rare-earth nuclei simultaneously with the change of mean square radii $\delta\langle r^2\rangle$. The calculation is based on Migdal's theory of finite Fermi systems including both ph and pp residual interactions. It is found that the liquid drop relation between $\delta\langle Q\rangle$ and $\delta\langle r^2\rangle$ is not valid in general; in agreement with experimental data, $\delta\langle Q\rangle$ is obtained larger than expected from $\delta\langle r^2\rangle$. (auth)

18739 (JINR-P2-6874) GAMOW-TELLER 1^+ (K = 0) EXCITATIONS IN ODD-ODD NUCLEI. Gabrakov, S. I.; Kuliev, A. A.; Schulz, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

The 1^+ (K = 0) states in deformed odd-odd nuclei are studied. It is shown that the charge exchange interaction leads to the production of nonidentical particle-hole collective 1^+ (K = 0) states which exhaust the main force of γ transition and can be interpreted as Gamov-Teller 1^+ O resonance. (1 figure, 1 table) (auth)

18740 (LBL-1276) MOESSBAUER SPECTROSCOPY OF THE 6.2 keV γ RAY TRANSITION OF ^{181}Ta. Salomon, D. B. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Sep 1972. Contract W-7405-eng-48. 101p. Dep. NTIS.

Thesis.

Recoilless nuclear resonance absorption of the 6.2-keV γ rays of ^{181}Ta was used for the hyperfine interactions of dilute ^{181}Ta impurities in the 5d, 4d, and 3d transition metals (Hf, Ta, W, Re, Os, Ir, Pt, Nb, Mo, Ru, Rh, Pd, V, and Ni) and the Ta compounds $LiTaO_3$, $NaTaO_3$, $KTaO_3$, and TaC. Ratios of the nuclear parameters of the 6.2-keV excited state ($I = 9/2$) to the ground state ($I = 7/2$) were derived from completely resolved magnetic and electric quadrupole split spectra, $g(9/2)/g(7/2) = 1.77 \pm 0.02$ and $Q(9/2)/Q(7/2) = 1.133 \pm 0.010$, and estimates for the mean-square nuclear charge radius were obtained: $\Delta\langle r^2\rangle \begin{cases} \sim -1.6 \text{ fm}^2 \\ \sim -4.5 \text{ fm}^2 \end{cases}$. The measured isomer shifts covered a range of 110 mm/s, corresponding to 17,000 times the natural line width or more than 1,600 times the best experimental line width of the 6.2 keV transition. In addition, both the sign and the magnitude of the electric field gradient were measured in the hexagonal transition metals Hf, Re, Os, and Ru, and in the tantalum compounds $LiTaO_3$ and $NaTaO_3$. Temperature studies of the isomer shifts in the transition metals, Ta, W, Ir, Pt, Mo, Pd, and Ni, were carried out, which showed shifts of the isomer shifts much larger than the second-order Doppler shift. Moessbauer-NMR is reviewed in connection with the ^{181}Ta resonance. (29 figures, 13 tables, 91 references) (auth)

18741 LEVELS OF ^{155,157,159,161}Tb EXCITED IN HELIUM INDUCED SINGLE PROTON TRANSFER REACTIONS. Boyno, J. S. Rochester, NY; Univ. of Rochester (1972). 237p. University Microfilms Order No. 72-28,727.

Thesis.

The (^{3}He,d) and (^{4}He,t) reactions on ^{154,156,158,160}Gd were run with 25.5 MeV ^{3}He and 27.0 MeV ^{4}He particles, respectively. (^{3}He,d) reactions on the three heavier mass targets were performed at $\theta_L = 60°$, while the (^{3}He,d) reaction on ^{154}Gd was run at 80° to avoid impurity contamination. The (^{4}He,t) experiments were run at 60 and 90°, although the ^{154}Gd(^{4}He,t) exposure was not used because of a high background due to slit scattering. The outgoing deuterons and tritons were analyzed in an Enge type spectrograph and recorded on nuclear emulsion plates, type NTB50. DWBA analysis was used to interpret the reaction results, and the spectroscopic information obtained was compared to the theoretical predictions of the Nilsson model, expanded to include tetroidal deformation. Corrective terms added to the simple model included calculation of the Coriolis interaction, and an estimation of the effect of the pairing interaction on the excitation energies and intensities of the observed states. Qualitative comparisons of experiment to the theoretical predictions of Soloviev, which deal with the single particle-vibrational coupling, were also performed. Level identifications were based on radioactive decay work, comparison of rotational band intensity "fingerprints" and energy systematics with theoretical predictions, and on the l value discrimination available from the cross section ratios $d\sigma(^3He,d)/d\sigma(^4He,t)60°$, $d\sigma(^3He,d)/d\sigma(^4He,t)90°$, $d\sigma(^3He,d)/S_{^4He}\, d\sigma(^4He,t)^{60°}/d\sigma(^4He,t)^{90°}$ all of which are predicted to be l dependent. These ratios provided useful l value information for a majority of the lines observed. Bands observed are: ^{155}Tb, [411↑](g.s), [413↓], [532↑], ([402↑]), ([411↓]), ([411↑]γ), ([514↑]); ^{157}Tb, [411↑](g.s.), [413↓], [532↑], [411↑]γ, [404↓], [402↑], [411↓], ([541↓]); ^{159}Tb, [411↑](g.s.), [413↓], [532↑], [411↑]γ, [404↓], ([523↑]), [411↓], [402↑], ([541↓]); ^{161}Tb, [411↑](g.s.), [413↓], [523↑], ([532↑]), [404↓], [411↓], ([541↓]), [402↑]. The parentheses indicate uncertain assignments. The observed energy systematics and intensity patterns indicate that the Nilsson model, when taken with Coriolis coupling and pairing corrections, is sufficient to describe the majority of observed states. In the particular case of the [411] [411]γ band, a large amount of single particle strength is observed, which agrees qualitatively with the prediction of the single particle-vibrational coupling model. Few states above 1300 keV were observed in both the (^{3}He,d) and (^{4}He,t) experiments, however, and it is impossible to come to any conclusions about the usefulness of these models for higher excited states. (Diss. Abstr. Int., B)

18742 GAMMA RADIATION IN ^{183}Re DECAY. Brabec, V.; Maly, L. (Inst. of Nuclear Physics, Prague). Czech. J. Phys.; 22: No. 12, 1226-1231(1972).

The gamma-ray intensities have been determined by means of Ge(Li) detectors. The previously proposed decay scheme has been tested using Ge(Li) γ-γ spectrometers. It has been found that the experimental data are not in disagreement with the foregoing decay scheme. The comparison of the theoretical (if the Coriolis interaction is taken into account) and experimental gamma line intensity ratios is given. (auth)

18743 HYPERFINE ANOMALY IN ^{151}Eu AND ^{153}Eu. Crecelius, G. (Freie Univ., Berlin). Z. Phys.; 256: No. 2, 155-75(1972). (In German).

Using the Moessbauer effect, the ratios of the g factors and the hyperfine splitting constants for the 21.6 keV state and the ground state in ^{151}Eu and of the 103 keV state and the ground state in ^{153}Eu have been measured. From these results, values for the hyperfine anomaly of $^0\Delta^{22}_{151} = -0.81(8)\%$ and $^0\Delta^{103}_{153} = +1.8(8)\%$ have been derived for ^{151}Eu and ^{153}Eu, respectively. (auth)

18744 ANGULAR CORRELATION IN ^{187}Re. Keszthelyi, L.; Demeter, I. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 187-91(1972).

The angular correlation coefficient of the 72 to 134 keV cascade of ^{187}Re was measured to be $A_2 = -0.006$ (2). This is an order of magnitude smaller than previous results. (auth)

18745 E1 INTERBAND TRANSITIONS BETWEEN ROTATIONAL BANDS IN ODD-PROTON NUCLEI. Winter, G.; Funke, L.;

Kemnitz, P.; Sodan, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger). Nucl. Phys.; A199: No. 1, 1-13(1973).

The E1 interband transitions between $1/2^+[411]$ and $1/2^-[541]$ in ^{161}Ho, ^{163}Ho, ^{167}Tm, ^{171}Lu, and ^{173}Lu, between $7/2^+[404]$ and $7/2^-[523]$ in ^{161}Ho, between $5/2^-[532]$ and $3/2^+[411]$ as well as between $5/2^+[413]$ and $5/2^-[532]$ in ^{153}Eu, ^{155}Tb, and ^{157}Tb were investigated. The γ-ray intensities of the interband transitions were compared with those of the rotational E2 transitions de-exciting the same rotational level. From these branching ratios and B(E2) values evaluated on the basis of the rotational model, B(E1) values for the interband transitions were deduced and compared with the predictions of the Nilsson model. Other B(E1) values obtained by lifetime measurements were also included in this comparison. The influence of the pairing correlations is discussed for the transitions between the bands $1/2^+[411]$ and $1/2^-[541]$. The probabilities of the transitions between these bands in ^{171}Lu were calculated on the basis of non-adiabatic wave functions, resulting from Coriolis mixing calculations. Interband transitions between levels with equal spins in the bands $5/2^-[532]$ and $3/2^+[411]$ are relatively hindered compared to those connecting levels with different spins. (4 figures, 7 tables) (auth)

18746 NUCLEAR DEFORMATIONS FROM THE INTERFERENCE EFFECTS BETWEEN COULOMB AND NUCLEAR EXCITATIONS IN INELASTIC α SCATTERING ON ^{152}Sm. Brueckner, W.; Merdinger, J. G.; Pelte, D.; Smilansky, U.; Traxel, K. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Rev. Lett.; 30: No. 2, 57-60(8 Jan 1973).

α particles in the energy range 11 to 18 MeV were used to excite the 2^+ and 4^+ members of the ground-state band in ^{152}Sm. The measured excitation probabilities were analyzed in the framework of Coulomb excitation and the deformed optical model. The resulting electrical transition matrix elements and optical-model deformation parameters are $\langle 0^+||m(E2)||2^+\rangle = (1.86 \pm 0.03)e$ b, $\langle 0^+||m(E4)||4^+\rangle = (0.37 \pm 0.09)e$ b^2, $\beta_2 = 0.214 \pm 0.007$, and $\beta_4 = 0.038 \pm 0.007$. (auth)

18747 MAGNETIC PROPERTIES OF ^{159}Tb, ^{172}Yb, AND ^{182}W NUCLEI. Begzhanov, R. B.; Muminov, A. I.; Il'khamdzhanov, N. A.; Yuldashev, U. Yu.; Salikhbaev, A. T. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 1, 32-35 (1972). (In Russian).

The magnetic moments of the excited states at 58 keV in ^{159}Tb; 79 and 260 keV in ^{172}Yb; and 100, 329, and 1289 keV in ^{182}W were measured by the perturbed angular correlation method. The sources ^{159}Gd and ^{182}Ta were obtained by irradiating ^{158}Gd and natural Ta in a neutron flux; the source ^{172}Lu, from proton irradiation of ^{172}Yb. (2 tables) (KSW)

18748 NEUTRON HOLE STATES IN ^{138}La AND ^{140}Pr. Helton, V. D. (Texas A and M Univ., College Station); Hiebert, J. C.; Ball, J. B. Nucl. Phys.; A201: No. 2, 225-246(1973).

Protons accelerated to 30 MeV were used to investigate low-lying states in the odd-odd nuclei ^{138}La and ^{140}Pr with (p,d) reactions. The elastic scattering of 30-MeV protons and 23-MeV deuterons was also studied to determine optical potentials. Experimental angular distributions are compared with distorted-wave Born approximation calculations to extract spin, parity, and spectroscopic factors for levels up to 432 keV of excitation in ^{140}Pr and 530 keV in ^{138}La. Comparisons with the simple shell-model predictions and extended shell-model calculations are presented. The ^{140}Pr levels appear experimentally to have an almost pure particle-hole structure whereas the ^{138}La levels exhibit substantial mixing. (auth)

18749 HIGH-SPIN STATES AND ROTATION-PARTICLE COUPLING IN ^{179}W. Lindblad, T.; Ryde, H.; Kleinheinz, P. (Research Inst. for Physics, Stockholm). Nucl. Phys.; A201: No. 2, 369-389(1973).

The ^{178}Hf(α,3n)^{179}W and ^{181}Ta(p,3n)^{179}W reactions are used to populate rotational states in ^{179}W. Particular attention is paid to the strongly perturbed positive-parity bands. The rotational energies within these bands are successfully explained within the unified model with pairing and Coriolis interactions included if the theoretical Coriolis matrix elements are reduced. The wave functions are calculated from a fit to the experimental energies, and the theoretical and experimental transition probabilities are compared. Rotational bands built on the $7/2^-[514]$, $1/2^-[521]$ and $5/2^-[512]$ intrinsic states are also observed. (auth)

18750 STUDY OF THE GROUND STATE ROTATIONAL BANDS OF $^{168\ 170\ 172}$Yb BY (HI,xn) REACTIONS. Mo, J. N.; Chapman, R.; Dracoulis, G. D.; Gelletly, W.; Hartley, A. J. (Univ. of Manchester, Eng.). Particles Nucl.; 4: No. 2-3, 126-42(1972).

The ground-state rotational bands of $^{168\ 170\ 172}$Yb were studied by observing the γ rays emitted following (^{4}He,xn) and (^{12}C,xn) reactions. On the basis of measurements of excitation functions, γ-ray angular distributions, and γ−γ coincidences, level schemes for the ground-state bands of these three nuclei were established. The results are discussed in terms of recent theoretical calculations. (8 figures, 4 tables) (auth)

18751 ^{154}Eu → ^{154}Gd DECAY. Nagpal, T. S.; Gaucher, R. E. (Bishop's Univ., Lennoxville, Quebec). Can. J. Phys.; 50: No. 21, 2688-2690(1 Nov 1972).

The γ and electron conversion spectra in the ^{154}Eu → ^{154}Gd decay have been observed using solid state detectors. The results have improved the available conversion data on this decay. (auth)

18752 NEGATIVE-PARITY ROTATIONAL BANDS IN ^{179}W. Birattari, C.; Grassi Strini, A. M.; Lo Bianco, G.; Strini, G.; Tagliaferri, G. (Univ., Milan). Nuovo Cim. A; 13A: No. 2, 453-469(21 Jan 1973).

The negative-parity bands built on the $7^-/2(514)$ and $1^-/2(521)$ orbitals have been excited in odd-A ^{179}W by means of the ^{181}Ta (p,3nγ) reaction. From in-beam experiments with Ge(Li) spectrometers, several previously unreported high-spin levels in ^{179}W are found by measurements of singles, coincidences, angular distributions and excitation functions. The rotational parameters of the two bands are determined by least-squares fits to the observed energies, and satisfactory accord is obtained with the previsions of the strong coupling model in the approximation of weak perturbation. An unusually low upper limit of 0.035 is deduced for the quantity $|g_K - g_R|$, related to the magnetic properties of the $K = 7^-/2$ ground-state band. The analysis of the angular distributions indicates an appreciable degree of alignment for the angular momenta of the ^{179}W nuclei resulting from reactions induced by protons of energy higher than about 20 MeV. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 18674, 18680, 18715, 18719, 18727, 18783, 18843, and 18845.

18753 NUCLEAR ORIENTATION OF $I = 13/2$ ISOMERS OF MERCURY AND LEVEL CROSSING IN ^{199m}Hg. Reimann, R. J. Seattle; Univ. of Washington (1972). 139p. University Microfilms Order No. 72-28,652.

Thesis.

An optical pumping technique has been used to orient four nuclear spin $I = 13/2$ isomers of mercury and two $I = 1/2$ radioisotopes as well as stable $I = 1/2$ ^{199}Hg and $I = 3/2$ ^{201}Hg. Measurements of ratios of the nuclear magnetic resonance frequencies of these isotopes to that of ^{199}Hg contained in the same sample cell have been made. In addition, a level crossing technique was used to observe the crossing of the hyperfine sublevels $(F,m_F) = (15/2, 15/2)$ and $(13/2, 11/2)$ in the $6\ ^3P_1$ state of ^{199m}Hg. This crossing occurred at a magnetic field value corresponding to a resonance frequency for protons in pure water of 32.926 5(13) MHz. The magnetic dipole interaction constant $A(^3P_1)$ free from the perturbing effect of nearby fine structure states was obtained by assuming a value for the quadrupole interaction constant B. The result is $A(^3P_1) = -2298.3(2)$ MHz for $B = -900(300)$ MHz, a B value consistent with measurements for other $I = 13/2$ isomers. However, there is some indication that the combination of $A(^3P_1) = -2299.3(1)$ MHz and $B = -1800(200)$ MHz is also reasonable. Values of $A(^3P_1)$ were calculated from available data for the other mercury isotopes and were combined with the above ratios of the nuclear resonance frequencies to give differential hyperfine structure anomalies. Magnetic moments and hyperfine structure anomalies were also predicted with a nuclear configuration mixing model and compared with the experimental results. Shell model configurations are suggested which give an over-all consistency. (Diss. Abstr. Int., B)

18754 EVIDENCE FOR E2 RESONANCES AT HIGH EXCITATION ENERGIES IN ^{208}Pb. Buskirk, F. R.; Graef, H. D.; Pitthan, R.; (and others) (Technische Hochschule, Darmstadt, Ger.). Phys. Lett.; 42B: No. 2, 194-6(27 Nov 1972).

Low-energy inelastic electron scattering experiments have been performed for ^{208}Pb with excitation energy ranging from 5 to 22 MeV. Resonances are observed at 7.3, 7.9, 8.9, 10.2, 10.6, 11.2 and 14.1 MeV. For the triplet at 10.2, 10.6 and 11.2 MeV, evidence is presented for an E2 assignment, with a reduced transition probability $B(E2,0) = (2.6 \pm 0.9) \times 10^3$ fm^4. (auth)

18755 SUPERHEAVY COMPOUND NUCLEI INVESTIGATED WITH IN-FLIGHT MASS SPECTROSCOPY. Colombani, P.; Gatty, B.; Jacmart, J. C.; (and others) (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 42B: No. 2, 208-10(27 Nov 1972).

Targets of ^{208}Pb, ^{232}Th and ^{238}U have been bombarded with 500 MeV ^{84}Kr ions in an attempt to observe superheavy nuclei which could be formed by fusion. The mass identification was done in flight on recoiling nuclei. No superheavy compound nuclei were observed from any of the targets. Upper limits of formation cross sections were found of ≈1 μb for Pb, 5 μb for Th and 80 μb for U targets. (auth)

18756 EXPERIMENTAL STUDIES WITH 14-MeV NEUTRONS. Adam, Andras (Central Research Inst. for Physics, Budapest). Magy. Fiz. Foly.; 20: No. 4, 335-430(1972). (In Hungarian).

The whole body of research activity carried out with 14-MeV fast neutrons by the author and research group during the last decade is reported. The new experimental methods and results as well as the nuclear physics involved are described. The work required the design and construction of an accelerator, improvement of a nanosecond measuring technique, and the study of pulse formation and time resolution. Recoil alpha particles from the ^{3}H(d,n)^{4}He neutron-generating reaction were used for measuring the time. It was found that combination of techniques based on recoil α particles and pulsing presents many advantages. A so-called compensation technique was developed to measure the time in fast-neutron time-of-flight measurements involving the detection of protons. A multichannel analyzer and a related computer program were also developed. In the nuclear physics part of the study, the mechanism of the (n,2n) reaction in Bi and Pb nuclei was investigated by recording coincidences of emitted neutrons and determining cross sections at energies near 14 MeV; no shell effect could be detected. Study of the α decay of the U nucleus induced by fast neutrons revealed the existence of the ^{238}U(n,αn′) ^{234}Th reaction. No anomalies were encountered in the study of the elastic scattering of 14-MeV neutrons by U targets. (67 figures, 2 tables) (TTT)

18757 TOTAL ABSORPTION MEASUREMENTS FOR 450 TO 1000-MeV PHOTONS IN VARIOUS MATERIALS. Miyachi, T. (Tokyo Univ.); Akino, Y.; Gomi, K.; (and others) J. Phys. Soc. Jap.; 34: No. 1, 14-17(Jan 1973).

The total absorption cross sections of photons in copper, silver, tin, tantalum, tungsten, and lead were studied for photon energies at 450, 700, and 1000 MeV. A comparison was made between experimental and theoretical cross sections. The Hartree–Fock–Slater cross section agreed with experimental results with an accuracy of the order of 1%. (auth)

18758 E1, TRANSITION PROBABILITIES IN THE ^{200}Pb, ^{198}Pb, ^{196}Pb, and ^{194}Pb ISOTOPES. Albouy, G. (Paris Univ., Orsay, France); Lagrange, J. M.; Pautrat, M.; (and others). J. Phys. (Paris); 33: No. 10, 835-840(Oct 1972). (In French).

The half-lives of the first 5^- levels were measured for the following isotopes: ^{200}Pb (level energy: 1908 keV, $T_{½} = 1.32 \pm 0.07$ ns); ^{198}Pb (level energy: 1823.6 keV, $T_{½} = 49 \pm 5$ ns), ^{196}Pb (level energy: 1797.3 keV, $T_{½} = 130 \pm 10$ ns), ^{194}Pb (level energy: 1819 keV, $T_{½} \leq 5$ ns). The B(E1; $5^- \rightarrow 4^+$) transition probability is deduced by considering a surface delta interaction on the basis of two quasi-particle states. The following neutron states were considered: $h_{9/2}$, $f_{5/2}$, $i_{13/2}$, $p_{3/2}$, $f_{7/2}$, $p_{1/2}$, $g_{9/2}$, and $i_{11/2}$. (France)

18759 ELECTRON CAPTURE DECAY OF ^{195}Au. Goverse, S. C.; Van Pelt, J.; van den Berg, J.; Klein, J. C.; Blok, J. (Vrije Univ., Amsterdam). Nucl. Phys.; A201: No. 2, 326-336(1973).

The decay of ^{195}Au was investigated by means of a 4π internal source scintillation spectrometer and a Ge(Li) detector. Electron capture branching ratios and several L/K and M+ .../L capture ratios were measured. The atomic electron capture transition energy and the cross-over decay probability of the 130 keV state were calculated. (auth)

18760 LEVELS OF ^{192}Pt AND ^{192}Os. Prasad, R.; Ram, S. P.; Chaturvedi, L.; Chaturvedi, S. N.; Nigam, A. K. (Banaras Hindu Univ., India). Curr. Sci. (India); 42: No. 1, 16-17(5 Jan 1973).

There have been inconsistencies in the number of existing levels and the gamma transitions in both ^{192}Pt and ^{192}Os. The decay of ^{192}Ir was studied using a high-resolution Ge(Li) gamma spectrometer in order to remove these inconsistencies. (WDM)

18761 ORIGIN OF FISSION FRAGMENT TRACKS IN LEAD GLASS. Flerov, G. N.; Perelygin, V. P.; Otgonsuren, O. At. Energ. (USSR); 33: No. 6, 979-984(Dec 1972). (In Russian).

The origin of fission fragment tracks, observed when etching old lead glass, was investigated. By means of the recording technique of track coincidence in two layers of polymeric film, it was shown that this effect is due, apparently, to the fission of lead nuclei induced by the nucleon component of cosmic radiation. The probability for lead fission due to the nucleon component is found to be (15 ± 4) fissions/g per year. (4 figures, 20 references). (auth)

18762 PHOTOEXCITATION OF ^{209}Bi AND ^{nat}Hg USING NEUTRON-CAPTURE γ-RAYS FROM COBALT. Mecca, S. J.; Rothamel, J. R. (Providence Coll.). Nucl. Phys.; A201: No. 3, 570-578(1973).

Using neutron-capture γ rays from cobalt, the ^{209}Bi(γ,γ′) and Hg(γ,γ′) reactions were studied using a 53 cm^3 Ge(Li) detector and the reactor facility at the Rhode Island Nuclear Science Center. Resonant scattering was observed at 4.924 ± 0.005 MeV for ^{nat}Hg. Resonant scattering was observed at 5.609 ± 0.005 MeV in ^{209}Bi, with an effective cross section of 348 ± 70 mb. The ratio of intensity scattered at 150° to that scattered at 100° was found to be 1.18 ± 0.12 for ^{209}Bi. This is consistent with a dipole transition to a $^9/_2$ state but does not eliminate other transitions and spin assignments. No significant inelastic structure was found in the spectra from either sample. The improved energy specification in the present experiments has led to different energy assignments for the resonant states and hence, different incident intensities are producing the observed scattering. These differences lead to higher effective cross sections than those previously reported. Minimum ground state level widths for ^{209}Bi and ^{nat}Hg were estimated to be 0.032 eV and 0.43 eV respectively. The need for high-resolution survey data to re-establish systematics is suggested. (auth)

18763 INVESTIGATION OF PHASE TRANSITION IN DENSITY OF THE EXCITED STATES OF EVEN–EVEN NUCLEI OF Po IN (α,f)–REACTION. Okolovich, V. N.; Itkis, M. G.; Kuvatov, K. G.; Smirenkin, G. N. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 16: No. 6, 1150-1154(1972). (In Russian).

The results on measuring of cross-sections and angular anisotropy of Pb even-even isotope fission by α-particles with energy 29–46 MeV are reported. Energy dependence of both characteristics reveals considerable deviations from the Fermi-gas model, which may be explained as evidence for phase transition from superconducting state of fissioning nuclei to the normal one. The values for the critical transition energy $E_{crit.}$ and correlation function in the ground state Δ_0 were determined. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 17818, 18229, 18640, 18710, 18714, 18755, 18756, 18786, 18816, 18845, and 18866.

18764 (COO–1162-46) RADIOCHEMICAL STUDIES OF NUCLEAR FISSION AND SEARCH FOR ELEMENT 118 (EKA-RADON). Progress Report, April 1, 1972–March 31, 1973. Wahl, A. C. (Washington Univ., St. Louis, Mo.). 1972. Contract AT(11-1)-1162. 30p. Dep. NTIS.

The results of the yield measurements reported last year for the ^{128}Sb and ^{130}Sb isomers and for ^{129}Sb and ^{130}Sn from thermal-neutron-induced fission of ^{235}U were prepared for publication. Also, the fractional cumulative yield of ^{131}Sn was determined to be 0.33 ± 0.06, and the half-lives of ^{132}Sb and ^{133}Sb were determined to be 3.4 ± 0.1 min and 2.7 ± 0.1 min, respectively. Evidence for the existence of isomerism for ^{132}Sb is reviewed. Prior to remeasuring fission yields of technetium isotopes, experiments were carried out to develop a rapid technetium–molybdenum separation procedure that will include all chemical forms of technetium present, because previously reported procedures excluded some lower oxidation states. It was shown that the rather efficient transfer of ^{139}Ba from ignited platinum or gold surfaces (~15% recoil yield) is indeed associated with the decay of ^{139}Cs since ^{140}Ba and ^{138}Cs are not transferred. The ^{139}Ba probably recoils as a positive ion since it may be collected efficiently even at increased gas pressures (to 5 torr), which, without the field, reduce the recoil yield by an order of magnitude. Two new instruments were designed and built in the cyclotron shop; one will be used to investigate recoil from beta decay of short-lived fission products, and the other will be used to search for isotopes of element 118 (eka-radon). Preliminary tests of both instruments were made. (4 figures, 3 tables) (auth)

18765 (COO–1167-22) TECHNICAL PROGRESS REPORT ON NUCLEAR CHEMISTRY RESEARCH, DECEMBER 31, 1971 TO DECEMBER 31, 1972. Sugarman, N.; Turkevich, A. (Chicago Univ., Ill. Enrico Fermi Inst.). 31 Dec 1972. Contract AT(11-1)-1167. 25p. Dep. NTIS.

Papers published during the period are reported, along with brief summaries of work in progress. The latter include fission and spallation by high-energy protons, production of ^{7}Be, ^{22}Na, ^{27}Al, and ^{149}Tb by intermediate-energy protons, analysis of meteorite composition, and development of radiation detection equipment. (RWR)

18766 (COO-3643-8) STATISTICAL THEORY FOR THE RATIO OF ISOMER TO PROMPT AND NEUTRON TO PROMPT CROSS SECTIONS. Sperber, D.; Aframe, A. (Rensselaer Polytechnic Inst., Troy, N. Y.). 1973. 9p. Dep. NTIS.

A new method for the calculation of the ratios between several cross sections in nuclei in which prompt fission, isomeric fission and neutron evaporation dominate is presented. The theory gives very good agreement with experiment. (auth)

18767 (JINR-E15-6807) PRODUCTION OF SPONTANEOUSLY FISSIONING ISOMERS IN Th, U, Np, Pu, AND Am ISOTOPES IN REACTIONS INDUCED BY 14.7-MeV NEUTRONS. Belov, A. G.; Gangrskii, Yu. P.; Dalkhsuren, B.; Kucher, A. M.; Nagy, T.; Nadkerni, D. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 11p. Dep. NTIS (U. S. Sales Only).

The cross sections for the formation of spontaneously fissioning isomers were measured in (n,2n) reactions on ^{239}Pu, ^{241}Pu, ^{240}Am, and ^{242}Am and in (n,n') reactions on ^{239}Pu and ^{243}Am induced by 14.7-MeV neutrons. Fission fragments were detected by means of a multiwire spark chamber. It was found that the spontaneously fissioning isomers are formed with considerably lower cross section in (n,n') reactions than in (n,2n) reactions. (2 figures, 1 table) (auth)

18768 (JINR-P6-6795) SEARCH FOR α-RADIATION IN THE DECAY OF SPONTANEOUSLY FISSIONING ISOMERS. Belov, A. G.; Gangrskii, Yu. P.; Dalkhsuren, B.; Kucher, A. M.; Nguyen Cong Khanh (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 12p. (In Russian). Dep. NTIS (U.S. Sales Only).

A search for α radiation in the decay of the spontaneously fissioning isomers ^{241}Pu, ^{240}Am, and ^{242}Am produced in (n,2n) reactions is described. α-emitters with an energy higher than 7 MeV and a half-life in the region of 10^{-5} to 10^{-2} s were not observed. This fact proves the existence of hindrance for α transitions in isomeric levels. (4 figures, 1 table) (auth)

18769 (LA-5048) GAMMA-RAY PRODUCTION CROSS SECTIONS FOR 1- AND 2-MeV NEUTRON INTERACTIONS WITH ^{235}U AND ^{239}Pu. Drake, D. M. (Los Alamos Scientific Lab., N. Mex.). Dec 1972. Contract W-7405-eng-36. 11p. Dep. NTIS.

Gamma-ray spectra were measured for 1- and 2-MeV neutron reactions with ^{235}U and ^{239}Pu by using a time-of-flight technique and an anti-Compton spectrometer. Gamma-ray production cross sections were determined and compared with previous measurements. (14 figures, 4 tables) (auth)

18770 (NIIAR-P-127) FISSION PRODUCT ENERGY SPECTRA COMPUTER PROCESSING. Basova, B. G.; Rabinovich, A. D. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 22p. (In Russian). INIS.

Two-dimensional distributions $N = f(m,E_{kin})$ and $N = f(m,\Sigma E_{kin})$ were obtained for fission products by computer processing of the data. Fission product energy spectra were determined with an ionization chamber. The results obtained were compared with data from a radiochemical analysis. (tr-auth).

18771 PERIODIC TABLE AND ITS POSSIBLE EXTENSION. Fields, P. R. (Argonne National Lab., IL). pp 82-124 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The nuclear properties and the means of production of the transuranium elements are discussed. This information is then extrapolated to the possible production and the properties of superheavy elements. Arguments for the existence of superheavy elements in nature are offered. Several new accelerator concepts that may provide the means of producing superheavy elements are mentioned. (JWR)

18772 REVISED DELAYED-NEUTRON YIELD DATA. Evans, A. E. (Los Alamos Scientific Lab., NM); Thorpe, M. M.; Krick, M. S. Nucl. Sci. Eng.; 50: No. 1, 80-82(Jan 1973).

Values of the yield of delayed neutrons from fission previously reported by Masters, Thorpe, and Smith and by Krick and Evans were reevaluated following refinement of earlier measurements and calibrations. Except for ^{238}U, the values for fast fission were in agreement with earlier results of Keepin. (auth)

18773 STUDY OF THE PHOTOFISSION AND PHOTONEUTRON PROCESSES IN THE GIANT DIPOLE RESONANCE OF ^{232}Th, ^{238}U, AND ^{237}Np. Veyssiere, A. (CEN, Saclay, France); Beil, H.; Bergere, R.; (and others). Nucl. Phys.; A199: No. 1, 45-64(1973).

Partial photoneutron cross sections $\sigma(\gamma,n)$ and $\sigma(\gamma,2n)$, together with photofission cross sections, $\sigma(\gamma,f)$, of ^{232}Th, ^{238}U, and ^{237}Np were measured using a monochromatic photon beam in the giant-resonance region. A new data analyzing technique was applied so as to make a direct separate and simultaneous evaluation of the above cross sections possible. Thresholds, absolute cross-section values, Lorentz line parameters, intrinsic quadrupole moments, and integrated cross sections were evaluated. A special study of the competition Γ_n/Γ_f between the fission and neutron exit channels is also presented. Finally, a determination of the "non-statistical" neutron contribution and an evaluation of the nuclear temperature of ^{237}U are also given. (auth)

18774 SUBNANOSECOND AND A NANOSECOND FISSION ISOMER IN ^{238}Pu. Limkilde, P.; Sletten, G. (Univ. of Copenhagen). Nucl. Phys.; A199: No. 3, 504-12(1973).

A subnanosecond fission isomer was found in ^{238}Pu by means of a new fission-in-flight technique. An isomer with a longer half-life reported previously in the same nucleus was detected simultaneously. The half-lives are 0.5 ± 0.2 ns and 5 ± 2 ns, respectively. Excitation functions show that the two isomers are separated by 1.3 ± 0.3 MeV, the short-lived isomer having the lower excitation energy. It is assigned as the ground state, while the 5-ns state is interpreted as a quasi-particle state in the second potential well. The difference of 1.3 MeV in excitation energy defines within the uncertainty the neutron energy gap at the isomeric deformation. (auth)

18775 MEASUREMENT OF FUNDAMENTAL NEUTRONIC CONSTANTS USING THE CADARACHE VAN DE GRAAFF GENERATOR. Abramson, D.; Arnaud, A.; Filippi, G.; (and others) (CEN, Cadarache, France). Bull. Inform. Sci. Tech. (Paris); No. 170, 61-78(May 1972). (In French).

The use in reactor physics of measurements of the fundamental neutron constants is discussed. The measurements made using the Cadarache Van de Graaff generator are described. The most important results concern the fission cross sections of ^{235}U, ^{239}Pu, ^{241}Pu, and certain reference cross sections, e.g., ^{6}Li(n,α)T. The current measurement project is oriented towards measuring the capture cross sections of the following structural materials: Fe, Ni, Cr, and ^{238}U. The fission neutron energy spectra were also measured. (France)

18776 NUCLEAR SHAPE ISOMERS. Polikanov, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Usp. Fiz. Nauk; 107: No. 4, 685-704(Aug 1972). (In Russian).

This paper constitutes a review of the subject of nuclear shape isomers and proposed models of these. The experimental investigation of the properties of spontaneously fissioning isomers is an important facet of the subject. The dependence of the half-lives of the spontaneously fissioning isomers on neutron number is demonstrated. The ground and isomeric states of the transuranium elements and the corresponding number of neutrons were considered. Curves of decay and of excitation of Pu and Am are exhibited and discussed, and the energies of isomeric states are compared. (46 references) (21 figures, 6 tables) (KSW)

18777 ENERGY SPECTRUM OF PROMPT NEUTRONS FROM THE FISSION OF ^{235}U BY 0.40-MeV NEUTRONS. Islam, M. M.; Knitter, H. -H. (Central Bureau for Nuclear Measurements, Geel, Belgium). Nucl. Sci. Eng.; 50: No. 2, 108-114(Feb 1973).

The prompt-fission-neutron energy spectrum of ^{235}U was measured at an incident neutron energy of 0.40 MeV with two samples of different thickness. The data were corrected for flux attenuation in the sample material and for effects due to the energy change of the out-going fission neutrons by inelastic scattering and secondary fission processes. After applying these shape corrections, an average fission neutron energy of 2.06 ± 0.05 MeV was obtained using the Watt and the Maxwellian functions for the energy distribution of the fission neutrons. This result is compared with the presently available results of other authors. (2 figures, 2 tables) (auth)

18778 FISSION BARRIERS OF HEAVY NUCLEI. Vorotnikov, P. E. At. Energ. (USSR); 33: No. 6, 995-996(Dec 1972). (In Russian).

The height of the fission barrier for the actinide elements was investigated as a function of Z^2/A and of N (the number of neutrons in the nucleus). The dependence of the value of $\hbar\omega_f$ on N proved to be a continuous function, lacking the expected discontinuity. (3 figures) (KSW)

18779 EXCITING MYSTERY OF NUCLEAR PHYSICS: FISSION. Kluge, Gyula (Central Research Inst. for Physics, Budapest). Fiz. Szemle; 22: No. 9, 278-282(Sep 1972). (In Hungarian).

Although nuclear fission was discovered more than 3 decades ago, no all-encompassing theory has yet been developed to explain the properties of strongly deformed nuclei and the consequences of elementary interactions on about 250 nucleons. The history of

these studies is outlined by mentioning first the concept developed by Bohr and Wheeler. It was not possible to explain the strong changes in the angular correlation of fission fragments on the basis of the liquid-drop model. The quasi-stationary quantum states at increased energy levels in strongly deformed nuclei, postulated by A. Bohr, are illustrated on the basis of typical levels of a fissioning even–even compound nucleus. Further progress was made when multiparameter measuring systems became available. The neutron number distribution of fragments from the spontaneous fission of ^{252}Cf indicated that the minimum neutron number is reached at mass number of A ~ 130; this was attributed to the presence of Z = 50, N = 82 double magic number. This phenomenon was explained by using the thermal equilibrium model when calculating the strong shell effect between the 2 nucleon systems. Fission of ^{237}Np and ^{240}Pu with resonance neutrons presented other surprising phenomena. Swiatecki's observations, the Strutinsky model and the compound nucleus concept, the resonances of the ^{230}Th(n,f) reaction, and the current investigation of the ^{236}U(n,γf) reaction are briefly mentioned. (Review article). (TTT)

18780 NEUTRONS OF ^{252}Cf FISSION. Blinov, M. V.; Kazarinov, N. M.; Krisyuk, I. T. Yadern. Fiz.; 16: No. 6, 1155-1160(1972). (In Russian).

The dependence of angular anisotropy and spectra of fission neutrons on the total kinetic energy of fragments of spontaneous ^{252}Cf fission has been studied. The obtained data are being compared with the same values, calculated in the model of neutron evaporation from fully accelerated fragments. Experimentally obtained deviations from the evaporation model may be explained by emission of a part of neutrons in a fast process directly related to the moment of nucleus fission. (auth)

18781 ENERGY DEPENDENCE $\bar{\nu}$ IN FISSIONING ^{235}U WITH FAST NEUTRONS. Savin, M. V.; Khokhlov, Yu. A.; Savel'ev, A. E.; Paramonova, I. N. Yadern. Fiz.; 16: No. 6, 1161-1166 (1972). (In Russian).

The results on measuring $\bar{\nu}$ in fissioning ^{235}U with fast 0.7–6 MeV neutrons are reported. The measurements were made at the Electron linac with a time-of-flight method (resolution I nsec/m) using a liquid scintillation detector. The mean value of $d\bar{\nu}/dE_n$ for ^{235}U measured in the present experiment, equals to $d\bar{\nu}/dE_n = 0.135$ at $0.7 \leq E_n \leq 4.5$ MeV and $d\bar{\nu}/dE_n = 0.225$ at $E_n > 4.5$ MeV. The calculation of energy dependence $\bar{\nu}$ in ^{235}U fission according to the statistic model is presented. (auth)

18782 MEAN NUMBER OF INSTANTANEOUS NEUTRONS IN ^{256}Fm SPONTANEOUS FISSION. Dakovskii, M.; Lazarev, Yu. A.; Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 6, 1167-1170(1972). (In Russian).

The results on measuring the mean number of prompt neutrons ($\bar{\nu}$) in ^{256}Fm spontaneous fission are reported: 3.73 ± 0.18 with respect to $\bar{\nu}$ (^{244}Cm) = 2.69 ± 0.02. ^{256}Fm ($T_{\frac{1}{2}}$ = 2,6 h) was synthesized in ion internal beam of U-300 Cyclotron of the Laboratory for Nuclear reactions of JINR. (auth)

18783 HIGH–ENERGY-PROTON FISSION CROSS-SECTIONS OF U, Th, AND Bi. de Carvalho, H. G.; Nazareth, R. A. M. S.; Stehney, A. F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 19: No. 2, 83-94(1972).

Cross sections were measured at 12.3 GeV with loaded nuclear emulsions. These were developed in a special way to distinguish fission-fragment tracks from those due to other processes. A semiempirical interpretation of the mechanism of the fission process from 100 MeV to ultra-high energies is discussed. For energies where the relative probability of the proton to neutron emission (p_p/p_n) is very low, the fission cross sections exhibit maximum value in a plateau region. The rising point of p_p/p_n in the neighborhood of 1 GeV coincides with the energy where the fission cross sections decrease abruptly. At energies higher than 10 GeV, the fission cross sections tend to an asymptotic value, owing to the fact that in the wide spectrum of excitation energies of the wide mass spectrum of residual nuclei, there are some nuclei with energies below the Coulomb barrier for charged-particle evaporation. (2 figures, 1 table) (RWR)

18784 STATISTICAL THEORY OF ISOMER RATIOS FOR SHAPE (FISSION) ISOMERS IN (n,γ) REACTIONS. Sperber, D. (Rensselaer Polytechnic Inst., Troy, NY). Nuovo Cim. 13A: No. 2, 373-384(21 Jan 1973).

A statistical theory is developed for the evaluation of isomer ratios for shape isomers. The method described in its present form is applicable for the calculation of isomer ratios in (n,γ) reactions. The method is used for the analysis of the isomer ratio for the reactions using as target ^{241}Am, ^{233}U, ^{235}U and ^{239}Pu. In most cases good agreement between theory and experiment is obtained. (auth)

Nuclear Theory

Refer also to abstracts 18251, 18259, 18347, 18354, 18360, 18426, 18433, 18489, 18501, 18681, 18682, and 19050.

18785 (CONF-730301-1) CAN WE GENERALIZE THE GIANT RESONANCE IDEA? Lewis, M. B. (Oak Ridge National Lab., Tenn.). 1972. 2p. Dep. NTIS.

It is pointed out that the term "giant resonance" is usually considered synonymous with "giant electric dipole resonance," but that this is a result of empirical methods, not theoretical speculation. Thus, a giant multipole resonance can be defined as any nuclear state (or group of overlapping states) that exhausts at least 50% of the energy-weighted sum-rule strength allowed for that multipole and type (isoscalar or isovector) of excitation. Results of measurements in which the bound states of ^{40}Ca and ^{208}Pb have been examined for their depletion of collective multipole sum-rule strengths are tabulated. It is clear from these data that any multipole could exhibit a resonance in the nuclear continuum that would satisfy the above definition. The possibility of observing any giant multipole resonance experimentally is considered, along with an apparent example in proton inelastic scattering by ^{40}Ca. (1 figure, 1 table) (RWR)

18786 (COO–3643-7) INTERMEDIATE STATE IN FISSION AND SHAPE ISOMERS. Sperber, Daniel (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Physics). 1972. Contract AT(11-1)-3643. 37p. Dep. NTIS.

The properties of shape isomers which lend themselves to statistical investigation are discussed. The study of isomer ratios, the ratio between isomeric and prompt fission cross sections, and the ratio between the cross section for the evaporation of a few neutrons and the cross section for prompt fission are considered. It is shown how the measured ratios yield information about the potential surfaces, the inertial parameters, and the level density. Various approaches to the study of the above ratios are presented. A time-dependent method based on the statistical compound-nucleus model is discussed in detail. The theory is compared with experiment. Good agreement between theory and experiment is obtained. (6 figures, 1 table) (auth)

18787 (FRNC-TH-282) NUCLEON-NUCLEUS POTENTIAL AND ANALOGUE STATES IN THE HARTREE–FOCK APPROXIMATION WITH SKYRME INTERACTION. Nguyen Van Giai (Paris Univ., Orsay (France)). 1972. 145p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The relation between the mean Skyrme–Hartree–Fock field and the optical nucleon–nucleus potential was studied by comparing the self-consistent field with the real part of the phenomenological optical potentials and then calculating directly the scattering states by this field. The Skyrme–Hartree–Fock model was then used to study certain properties associated with the Coulomb interaction. The results of calculations on the isospin impurity of the ground states demonstrate that these states have almost completely pure isospins. Investigations of the Coulomb energy differences ΔE_c between mirror nuclei indicate that the corrections due to the isospin impurity of these nuclei are insufficient to explain the difference between the theoretical values and the experimental values observed by Nolen and Schiffer. A model is then presented which describes the analog state of a doubly closed nucleus taking into account the coupling to the continuum. (France)

18788 (IKE–4-4) EXPANSION COEFFICIENTS FOR ISOTROPIC SCATTERING IN THE CENTER-OF-MASS COORDINATE SYSTEM ASSUMING 1/E FLUX AND A STATIONARY TARGET NUCLEUS. Wohland, H. (Stuttgart Univ. (West Germany). Institut fuer Kernenergetik). Jan 1972. 20p. (In German). INIS.

Formulas for expansion coefficients of transfer cross sections have been derived for energy points and groups. Analytic expressions for the first four terms of an expansion in Legendre polynomials are given. They have been calculated for isotropic scattering in the center-of-mass coordinate system assuming 1/E flux and a stationary target nucleus. Upscattering has not been considered. The expressions have been coded into Fortran-functions. (auth)

18789 (LBL–1296) SUMMARY TALK: EXPERIMENTAL. Kienle, P. (California Univ., Berkeley. Lawrence Berkeley Lab; Technische Universitaet, Munich (West Germany)). Nov 1972. Contract W-7405-eng-48. 11p. (CONF-720932–5). Dep. NTIS.

This paper is a summary talk presented at the end of the International Conference on Nuclear Moments and Nuclear Structure, Osaka, Japan, September 4–8, 1972. The use of the Moessbauer effect in nuclear-moment research is recalled, along with muon and exotic atom spectroscopy. The technique

of hyperfine neutron spectroscopy is described. The measurement of g factors and quadrupole-coupling constants is discussed, including experimental aspects. The importance of optical–pumping and atomic-beam methods combined with on-line mass separators and accelerators is mentioned. Measurement of quadrupole- and magnetic-interaction constants and Coulomb excitation are also included. (RWR)

18790 (N–72-25646) SHORT-RANGE CORRELATIONS IN ^{12}C, ^{16}O, AND ^{20}Ne: INTRINSIC PROPERTIES. Braley, R. C.; Ford, W. F.; Becker, R. L.; Patterson, M. R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jun 1972. 18p. (NASA-TN-D-6834; E-6836). NTIS.

The Brueckner–Hartree–Fock (BHF) method has been applied to nuclei whose intrinsic structure is nonspherical. Reaction matrix elements were calculated as functions of starting energy for the Hamada–Johnston interaction using the Pauli operator appropriate to ^{16}O and a shifted oscillator spectrum for virtual excited states. Binding energies, single particle energies, radii and shape deformations of the intrinsic state, in ordinary as well as renormalized BHF, are discussed and compared with previous HF studies and with experiment when possible. Results are presented for ^{12}C, ^{16}O and ^{20}Ne. It is found that the binding energies and radii are too small, but that separation energies are well reproduced when the renormalized theory is used. (auth) (STAR)

18791 (STI/PUB–305) STRUCTURE OF NUCLEI. Lectures Presented at an International Course, Trieste, January 13–March 12, 1971. (International Atomic Energy Agency, Vienna (Austria)). Jun 1972. 599p. IAEA $18.00.

Separate abstracts were prepared for each of the lectures published in this volume. (RWR)

For abstracts of individual papers see: 18569, 18681, 18682, 18851–18869, 18959, and 19052.

18792 HIGH ENERGY PROCESSES WITH NUCLEAR TARGETS. Nixon, G. D. Stanford, CA; Stanford Univ. (1972). 150p. University Microfilms Order No. 72-30,673.

Thesis.

In the past twenty years much information has been obtained on the ground and excited states of a wide variety of nuclei. Much of this work has used the electromagnetic interaction of electrons to probe nuclear structure. Experiments with hadronic probes have been more difficult to interpret as it has not been possible to easily and clearly separate the effects due to nuclear structure and those due to the scattering mechanism. At high energies, however, the theoretical treatment of hadron-nuclear scattering is very much simpler than at low energies. The theoretical framework appropriate at high energies is the multiple scattering theory of R. T. Glauber and is basically an extension of Fraunkofer diffraction theory. One aim of this thesis is to make nuclear structure corrections to the simple Glauber results and then make a unified analysis of a variety of high energy nuclear reactions [(p,p'), (n,n'), (π,π'), (γ,ρ^0), (γ,γ)]. This is important as a justification for the use of the theory itself and is necessary if new information is to be extracted from experimental data with precision. Specifically the effects of nuclear correlations on these processes are studied and to do this the first calculation of a realistic two-body nuclear correlation function is made. Next, the diffraction theory is used for studying nuclear transitions. The excitation of T = 0 nuclear levels in hadron scattering is studied within the framework oscillating drop nuclear model. Comparison with (e,e') scattering data allows one to account for the observed (p,p') incoherent scattering at 1.7 GeV/c. Finally, the excitation of T = 1 levels during photoproduction of charged pions is examined. The nuclear amplitude is computed using the particle-hole model for 28 nuclear excitations. The departure of this process from Fermi-gas model predictions can then be explained. (Diss. Abstr. Int., B)

18793 WEAK INTERACTION VECTOR COUPLING CONSTANT. Robinson, D. C. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand). pp 212-20 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The determination of the weak interaction vector coupling constant in superallowed $0^+ \rightarrow 0^+$ beta transitions is discussed. The current experimental situation concerning such studies is analyzed. (JWR)

18794 STATUS OF THE NUCLEAR SHELL MODEL. Lawson, R. D. (Argonne National Lab., IL). pp 222-64 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

A review on the development and current status of the nuclear shell model is presented. Phenomenological models as well as calculations from first principles are discussed (37 references) (JWR)

18795 SENIORITY NUMBER GENERALIZATIONS AND APPLICATIONS TO NUCLEI. Talmi, I. (Weizmann Inst. of Science, Rehovot, Israel). pp 266-85 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The odd-even variation in nuclear binding energies is pointed out as being the natural result of the seniority scheme. The concept of seniority is discussed and the need for its generalization is shown. Some unsatisfactory generalizations are discussed. A simple generalization is then constructed which agrees reasonably well with experimental data. (JWR)

18796 ADVANCES IN NUCLEAR STRUCTURE CALCULATIONS CRANKED HARTREE–FOCK SOLUTIONS. Stamp, A. P. (Univ. of Auckland, New Zealand). pp 286-94 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

The use of cranked Hartree–Fock calculations in nuclear structure studies of collective rotational motion is discussed. (JWR)

18797 ONE AND TWO BODY STRUCTURE IN ATOMIC NUCLEI. Manning, M. R. (Inst. of Nuclear Sciences, Lower Hutt, New Zealand). pp 296-310 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR: International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

After a brief introduction the topic of one and two body structure is discussed under the following headings: reduced density matrices, dynamical equations, the one-body equations, and the geminal equations. (JWR)

18798 PARTLY NONLOCAL POTENTIALS IN NUCLEAR MATTER. Singh, Y.; Warke, C. S.; Bhaduri, R. K. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 21, 2574-2586 (1 Nov 1972).

A set of phase-equivalent partly nonlocal two-nucleon potentials in the s state are constructed, with short range separable-type repulsion superimposed on a local attractive potential of longer range. Nuclear matter calculations with potentials of this type reveal qualitative differences when the results are compared with those obtained from phase-equivalent rank-two separable potentials. These differences are linked to the different behaviors of the two-body bound state wave functions generated by an attractive local potential and its phase-equivalent separable counterpart. (auth)

18799 TRUNCATION DEPENDENCE OF THE ^{40}Ca HARTREE–FOCK FIELD IN THE CONTINUUM. Lejeune, A.; Jeukenne, J. P. (Univ., Liege). Phys. Lett.; 42B: No. 2, 171-2(27 Nov 1972).

Phase shifts for the n-^{40}Ca elastic scattering are derived from a Hartree–Fock field obtained in a finite harmonic oscillator basis and truncation effects of this basis are shown to be important. (auth)

18800 ARE THERE SUPER BARRIER TRANSMISSION RESONANCES IN THE FISSION PROCESS? Hofmann, H. (Technische Univ., Munich). Phys. Lett.; 42B: No. 2, 177-80 (27 Nov 1972).

Penetrability functions for super barrier transmission of Wood–Saxon type barriers are studied. As a consequence of an increased inertia near the top of the barrier transmission resonances can be expected in the fission cross section. The influence of the presence of different channels is discussed. (auth)

18801 FUSION THRESHOLD ENERGY IN HEAVY-ION REACTIONS. Wong, C. Y. (Oak Ridge National Lab., TN). Phys. Lett.; 42B: No. 2, 186-90(27 Nov 1972).

The dependence of the fusion threshold energy is examined for various combinations of projectile and target nuclei. It is found that when the threshold energy is parameterized in the form $Z_1Z_2e^2/r_e(A_1^{\frac{1}{3}} + A_2^{\frac{1}{3}})$, the effective radius parameter r_e decreases as the charge of either the projectile or the target nucleus increases. The value of r_e is larger when either the projectile or the target nucleus is endowed with a permanent positive quadrupole moment. (auth)

18802 COULOMB EFFECTS IN DEUTERON-INDUCED DEUTERON BREAK-UP. Valkovic, V.; Duck, I. M.; Phillips, G. C. (Rice Univ., Houston, TX). Phys. Lett.; 42B: No. 2, 191-3(27 Nov 1972).

Coulomb effects in deuteron-induced deuteron break-up are introduced with Coulomb penetrability Fermi factors only for p–d amplitudes. An excellent agreement with experimental data in the 6 to 13 MeV range is obtained (auth)

18803 MULTIPOLE ANALYSIS OF POLARIZATION PHENOMENA DURING FAST-NUCLEON SCATTERING BY NUCLEI. Sitenko, A. G.; Fursa, A. D. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 1, 110-18 (Jan 1972). (In Russian).

On the basis of multipole formalism for description of nucleon scattering by nuclei, polarization and asymmetry for elastic and inelastic scattering of nucleons by ^{12}C are considered taking into account distortion due to spin-orbital interaction. The optical potential and its parameters are found from the nucleon-nucleon interaction in accordance with the theory of multiple scattering. The numerical calculations and comparison with the experiment are carried out for the case of elastic scattering as well as for the case of inelastic one of protons with excitation of ^{12}C states 2^+ T = 0 (4.44 MeV) and 3^- T = 0 (9.64 MeV). (auth)

18804 EVIDENCE FOR FISSION EFFECTS IN INCOMPLETE FUSION REACTIONS. Sikkeland, T. (Univ., Trondheim., Norway); Shafrir, N. H.; Trautmann, N. Phys. Lett.; 42B: No. 2, 201-4(27 Nov 1972).

A kinematic model is introduced for processes involving an incomplete fusion of two complex nuclei. This model is used in the analysis of experimental cross sections for nuclei produced in reactions where charged particles are emitted. Evidence is presented for a fission type process in the final stage of the incomplete fusion reaction. (auth)

18805 FRACTIONAL PARENTAGE DECOMPOSITION OF THE ORTHOGONAL SCHEME AND OF K-HARMONICS NUCLEAR WAVE FUNCTIONS AND FACTORIZATION OF THE FRACTIONAL PARENTAGE COEFFICIENTS. Vanagas, V. V.; Kalinauskas, R. K. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 2, 217-228(1972). (In Russian).

The fractional parentage decomposition of the orthogonal scheme and of K-harmonics nuclear wave functions is investigated and factorization formulas for fractional parentage coefficients as well as unitary scheme coefficients are given. Transformation between the oscillatory radial wave functions of arbitrary dimensions and Jacobi polynomials is presented. (auth)

18806 DESCRIPTION OF THE EXCITED U(3(n–1)) NUCLEAR STATES ON THE BASIS OF THE ASSUMPTION OF THE RADIAL COLLECTIVE OSCILLATIONS. Petrauskas, A. K.; Yankauskas, K. I.; Kamuntavichyus, G. P. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 2, 229-234(1972). (In Russian).

The possibility of the description of the excited U(3(n–1)) states in the orthogonal scheme on the basis of the assumption of the radial collective oscillations was considered. The explicit expressions of the matrix elements of any operators for the U(3(n–1)) states with fixed quantum number K are given taking into account these expressions, the excitation energy of the first O^+ states of nuclei ^4He, ^{12}C and ^{16}O are calculated and compared with experimental data. (auth)

18807 EXPLORING THE HISTORY OF NUCLEAR PHYSICS. Proceedings of the Conferences Held in Brookline, MA, 1967 and 1969. Weiner, C. (ed.). AIP Conference Proceedings, No. 7. New York; American Institute of Physics (1972). 289p. $10.00.

The two conferences held in 1967 and 1969 at Brookline were to lay the foundation for a formed history of nuclear physics. (WDM)

18808 DIRECT NUMERICAL CALCULATION OF THE TWO-NUCLEON CORRELATION FUNCTION FOR ^4He. Fantoni, S. (Univ., Pisa, Italy); Rosati, S. Lett. Nuovo Cim.; 5: No. 14, 931-4(2 Dec 1972).

A method of obtaining the best variational correlation function for a Jastrow wave function is illustrated. The two-nucleon correlation function for ^4He is calculated and used to evaluate the ^4He binding energy to the third order in a modified Van Kampen expansion. The results are compared with other calculations. (JWR)

18809 NARROW RESONANCES OF LASER-INDUCED γ-RAY EMISSION AND ABSORPTION BY NUCLEI. Letokhov, V. S. (Spectroscopy Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.); 16: No. 7, 304-6(5 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 7, 428-31(5 Oct 1972).

A method for obtaining narrow nuclear resonances in a gas is proposed. The method is based on the modulation of the frequency of the nuclear transition in molecules excited vibrationally by laser radiation and which have the same velocity projection on the direction of wave propagation. Applications of the method are discussed. (JWR)

18810 HOLE STATES IN SINGLE-PARTICLE KNOCK-OUT REACTIONS. Shanta, R. (Univ. of Liverpool). Nucl. Phys.; A199: No. 3, 624-40(1973).

The hole states created in single-particle knock-out reactions are physical states but have finite lifetime. The hole is moving in a complex potential, the imaginary part of which is related to the width of the state, and the hole energy and wave functions are complex. The influence of these features on the momentum distributions of the hole is studied for the knock-out of the 1s and 1p protons from ^{12}C and is found to be rather insignificant. However, it is interesting to note that the overlap integral in momentum space shows a significant change. (auth)

18811 NUCLEAR RESEARCH IN HUNGARY. Fiz. Szemle; 22: No. 10, 289-295(Oct 1972). (In Hungarian).

Topics discussed include the present situation of nuclear physics in Hungary, personnel and material requirements of nuclear physics investigations during the 1971 to 1985 planning period, goals of nuclear physics research, and international cooperation. (WDM)

18812 VREMENA ZHIZNI VOZBUZHDENNYKH SOSTOYANII ATOMNYKH YADER. (Lifetimes of Excited States of Atomic Nuclei). Berlovich, E. E.; Vasilenko, S. S.; Novikov, Yu. N. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1972). 232p.

This monograph contains systematized data in tabular form on the lifetimes of the excited states of nuclei accumulated to the beginning of 1972. The experimental values of lifetimes are useful in the calculation of probabilities of electromagnetic transitions of fixed multipole orders between two concrete nuclear levels. The theoretical relationships necessary for accomplishing these and allied computations are presented. (KSW)

18813 ANGULAR-MOMENTUM CONSERVATION IN THE STRUTINSKY METHOD. Ross, C. K.; Warke, C. S. (McMaster Univ., Hamiilton, Ont.). Phys. Rev. Lett.; 30: No. 2, 55-7(8 Jan 1973).

The effect of angular-momentum conservation on the nuclear deformation energy is obtained within the context of the Strutinsky method. In contrast to the results of Kelson and Shoshani, the correction to the fission barrier is found to be small (less than 200 keV) for all nuclei. (auth)

18814 1971 ATOMIC MASS EVALUATION IN FIVE PARTS. PART V. NUCLEAR-REACTION Q-VALUES. Gove, N. B. (Oak Ridge National Lab., TN); Wapstra, A. H. Nucl. Data, Sect. A; 11: No. 2-3, 127-280(Nov 1972).

Tables of ground-state Q-values for nuclear reactions are calculated from the results of the atomic mass evaluation. The calculations were performed for reactions whose targets include all the stable or naturally occurring radioactive isotopes with Z = 4 to 98. The incoming particles included are γ, n, p, d, t, ^3He, ^4He, ^6Li, ^7Li, ^9Be, ^{10}B, ^{11}B, ^{12}C, ^{14}N, ^{16}O, and ^{20}Ne. The outgoing particles or groups are γ, n, 2n, 3n, 4n, p, d, t, ^3He, and ^4He. (auth)

18815 OPTICAL MODEL OF THE ELASTIC SCATTERING OF DEUTERONS BY NUCLEI. Irshad, M. (Pakistan Inst. of Nuclear Science and Tech., Islamabad). Nucleus (Karachi); 9: No. 1-2, 9-18(1972).

Some salient features of the optical model as applied to the elastic scattering of deuterons and attempts at calculating it from appropriate neutron and proton optical potentials are summarized. The method of analysis is described, and the overall deuteron optical potentials derived from deuteron elastic scattering studies are reviewed. (4 figures, 46 references) (auth)

18816 SECOND BORN–SINHA APPROXIMATION CROSS SECTIONS OF POSITRON- AND ELECTRON-INDUCED DISINTEGRATION (FISSION). Sinha, B. B. P. (Univ. of Toronto). Lett. Nuovo Cim.; 5: No. 6, 508-12(7 Oct 1972).

The theory of electrodisintegration (electrofission) is treated through use of the second Born approximation. The cross sections for electrodisintegration (electrofission) are given explicitly in the second Born and Sinha approximations. To derive expressions for the virtual-photon spectrum in the second Born approximation analytic results for the distorted-wave Coulomb corrections to electron inelastic scattering were used. In the lower-energy region $q\langle R\rangle \leq 2$, where q is the four-momentum transfer and $\langle R\rangle$ is the rms charge radius of the nucleus; effects of the nuclear finite size can be considered in the radius approximation formalism. It is found that the radius approximation does not provide adequate answer for the problems dealing with electrofission or electrodisintegration. A new formalism is introduced to take into account the effects of finite size for these problems. The point-nucleus concept in the second Born approximation with finite size effects in Sinha's approximation provides a suitable basis and means for quite good fits with known experimental ratios of the cross sections for electron- and positron-induced disintegration. (RWR)

18817 FROM SOFT TO REAL PIONS IN NUCLEAR PHYSICS. Ericson, M. (CERN, Geneva); Rho, M. Phys. Rep.; 5C: No. 2, 57-124(1972).

This review treats the applications of soft-pion theorems to nuclei. After a general introduction to the soft-pion techniques, the partially conserved axial vector current hypothesis is discussed and its particular nature in the nuclear case is emphasized. The rest of the article treats the mass extrapolation problem. The relation between the physical and the soft-pion amplitude is derived for several processes, and its physical interpretation is discussed. (12 figures, 1 table, 75 references) (auth)

18818 FISSION AND FUSION DYNAMICS. Swiatecki, W. J. S. (Univ. of Aarhus, Denmark); Bjoernholm, S. Phys. Rep.; 4C: No. 6, 325-42(Sep 1972).

A unified macroscopic approach to the field of fission and heavy-ion fusion is stressed. The principal degrees of freedom relevant to this field are described. In the equations of motion there are three types of terms (potential, dissipative, and inertial terms). The principal features of the potential energy landscape are illustrated qualitatively by means of an example relevant to fission and super-heavy element formation. Evidence for strong dissipative (damping) effects associated with the motion of nuclear matter along the fission trajectory from the ground-state shape, past the saddle point, to some region between saddle and scission points is presented. Beyond this region the damping effects appear to diminish. A parallel trend in the effective mass of the fission motion is pointed out, and a connection between strong damping and increased inertia is suggested. Consequences of strong damping for the successful fusion of heavy nuclei are briefly discussed. (15 figures, 1 table) (auth)

18819 EXTENSION OF THE STRUTINSKI PRESCRIPTION TO FINITE WELL POTENTIALS. Tondeur, P. (Univ., Brussels). J. Phys. (Paris); 33: No. 10, 825-828(Oct 1972). (In French).

It is shown that Strutinski prescription may be used for finite well potentials if the correction factor is modified. (France)

18820 ELASTIC AND INELASTIC ELECTRON SCATTERING FROM NUCLEI AND DYNAMICAL INTERNUCLEON CORRELATIONS. Malecki, A. (Inst. of Nuclear Physics, Krakow). Zesz. Nauk. Uniw. Jagiellon., No. 231, Pr. Fiz.; No. 8, 99-107(1970).

A lecture is given on the information for dynamical nucleon–nucleon correlations which can be deduced from elastic and quasi-elastic electron scattering from nuclei. Restriction is made to the noncoincidence experiments where one observes only the final electron. (JFP)

18821 METHOD FOR CALCULATING THE SPECIFIC ACTIVITY OF FISSION PRODUCTS. Kovalenko, V. V.; Rubtsov, P. M.; Kolobashkin, V. M. (Moscow Engineering–Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz., No. 9, 32-34(1972). (In Russian).

An algorithm for calculating the specific activity of a member of a decay chain is described. Fission product activity may thus be determined for the three modes of accumulation: irradiation time in a reactor, the subsequent cooling time, and the hold-up time following instantaneous fission. The accuracy and convenience of the electronic computer facilitates the use of the proposed algorithm. (tr-auth)

18822 HIGHER APPROXIMATIONS IN e–γ ANGULAR CORRELATIONS. Kuzhir, P. G. (Belorussian State Univ., Minsk). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 43-45(1972). (In Russian).

A theory was constructed for the e–γ angular correlation for pure multipoles, allowing for the effects of higher approximations. The contributions of the higher approximations in the angular correlation function is not large. (tr-auth)

18823 COLLECTED WORKS OF LEO SZILARD. SCIENTIFIC PAPERS. Feld, Bernard T.; Szilard, Gertrud Weiss (eds.). Cambridge, Mass.; Massachusetts Institute of Technology Press (1972). 756p. $17.50.

The topics considered include biographical notes, published papers in physics, documents relating to the Manhattan project, published papers in biology, and patents, patent applications, and disclosures. (JFP)

18824 HIGH MOMENTUM TRANSFER APPROACH TO INELASTIC ELECTRON SCATTERING ON NUCLEI AND MODEL-INDEPENDENT DESCRIPTION OF NUCLEAR TRANSITION DENSITIES. Knoll, J. (Univ., Freiburg i.B.). Nucl. Phys.; A201: No. 2, 289-300(1973).

A method of approximating the DWBA transition amplitude at higher momentum transfers is given. It leads to quantitative agreement with the DWBA values, combined with a considerable saving of computing time. The method permits model-independent analyses of inelastic data at higher momentum transfers. The influence of uncertainties in the ground state charge density on the inelastic cross section is studied and found to be negligible. Regardless of the magnitude of Coulomb distortions, the multipole moments B(τ; L, q) are shown to be model-independent quantities for those values of q which lie in the region of measured momentum transfers. (auth)

18825 STUDY OF APPROXIMATION IN THE NUCLEAR PAIRING-FORCE PROBLEM. Pradhan, H. C. (McMaster Univ., Hamilton, Ont.); Nogami, Y.; Law, J. Nucl. Phys.; A201: No. 2, 357-368(1973).

The accuracy of the Lipkin–Nogami version of the BCS method is examined and compared with other methods, for the ground and 0^+ excited states of a symmetric two-level model. Unlike many other methods which fail for either very weak or very strong couplings, the Lipkin–Nogami method works well for any value of the force strength. (auth)

18826 TEST FOR SINGLE-POLE DOMINANCE IN HEAVY-ION SCATTERING. Londergan, J. T.; McVoy, K. W. (Univ. of Wisconsin, Madison). Nucl. Phys.; A201: No. 2, 390-400(1973).

Strongly absorbed particles like α-particles and heavy ions often exhibit large, oscillatory back-scattering, which at certain energies can be described by a single Regge pole in the elastic scattering amplitude. A simple procedure is presented which can be used to test any partial-wave decomposition or optical-model amplitude for the presence of such a pole. It determines the angular range over which the pole dominates the amplitude and provides an estimate of the position and width (in l) of the pole. Sample applications of the test are made to several amplitudes of current interest, including that of the Florida State l-dependent optical model for heavy-ion scattering. (auth)

18827 NUCLEI IN THE TERMINAL PARTS OF THE r-PROCESS PATH. Boleu, R. (Univ. of Lund). Nucl. Phys.; A201: No. 2, 401-417(1973).

Half-life calculations for various decay processes were made for neutron-rich elements with $Z \geq 90$ and with neutron numbers between the β-stability line and the neutron-drip line. The calculations are based on the modified oscillator model. The results, which are highly dependent on the size of the $N = 184$ neutron gap predicted by the model, appear not to permit the population of the superheavy region through the r-process, in contradiction to the results of a recent investigation by Schramm and Fowler. (auth)

18828 AMBIGUITIES AND SYSTEMATICS IN THE REAL CENTRAL PART OF THE OPTICAL-MODEL POTENTIAL. Cage, M. E.; Cole, A. J.; Pyle, G. J. (Univ. of Birmingham, Eng.). Nucl. Phys.; A201: No. 2, 418-432(1973).

An analytical description is presented which accounts for both the discrete and continuous ambiguities in the real central part of the optical-model potential. This procedure allows a systematic representation of the real central parts of the optical-model potentials to be made for p, d, ^{3}He and ^{4}He projectiles, and indicates which potential family is most appropriate for each projectile. (auth)

18829 SOME EXTENSIONS OF THE SCHEMATIC MODEL FOR CORE POLARIZATION OF THE NUCLEAR EFFECTIVE INTERACTION. Sprung, D. W. L.; Jopko, A. M. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 22, 2768-2775 (15 Nov 1972).

A number of higher-order core polarization processes recently considered by Kirson are here treated in the case of the soluble schematic model. We confirm the conclusion of Kirson that the sum of all the processes considered gives a very small contribution to the shell model effective interaction. In particular, the anomalously large results found in the RPA are overcome. (auth)

18830 EFFECTS OF NUCLEAR COLLECTIVITY ON THE TOTAL NEUTRON CROSS SECTION. Wong, C. Y. (Oak Ridge National Lab., TN); Tamura, T.; Marshak, H.; Langsford, A. Particles Nucl.; 4: No. 4, 163-74(Oct 1972).

The effect of the nuclear collectivity on the variation of the total neutron cross section with respect to the incident energy ranging from 4 to 20 MeV is studied. It is found that the higher the collectivity, the smoother is the excitation function for both deformed and vibrational nuclei. This feature is understood qualitatively in terms of the nuclear Ramsauer effect and is explained quantitatively by coupled-channels calculations. These calculations further reveal that deformed nuclei have larger total cross sections and smoother variations than do the vibrational nuclei. For vibrational nuclei, it is also found that the quadrupole deformation has a slightly larger effect on the smoothness than does the octupole deformation, if they have the same deformation parameter. (5 figures) (auth)

18831 EIGENCHANNEL METHOD AND RELATED THEORIES FOR NUCLEAR REACTIONS. Barrett, R. F.; (Univ., Frankfurt

am Main); Biedenharn, L. C.; Danos, M.; (and others) Rev. Mod. Phys.; 45: No. 1, 44-106(Jan 1973).

The theory of the treatment of particle–hole states in the continuum is reviewed with emphasis on the eigenchannel method. The results of actual calculations are compared with experimental data. Some aspects of the experiments are rather well reproduced by the calculations; however, in certain other aspects, a qualitative disagreement exists between theory and experiment, pointing to an essential inadequacy of the underlying nuclear model. (auth)

18832 QUASI-FREE SCATTERING AND NUCLEAR STRUCTURE. II. Jacob, G.; Maris, T. A. J. (Univ. Federal do Rio Grande do Sul, Porto Alegre, Brazil). Rev. Mod. Phys.; 45: No. 1, 6-21(Jan 1973).

This complement of an earlier paper [Rev. Mod. Phys. 38: 121 (1966)] reviews experimental and theoretical progress made since 1965 in the knowledge of quasi-free (p,2p) and (e,e'p) processes in nuclei. Some aspects of the reaction mechanism are considered, and a new method to present the experimental data is suggested. The character of the final hole states is discussed. New experimental results are presented, and the available information on "hole-spectroscopy" is summarized. Several open problems are pointed out. (auth)

18833 BETA ASYMMETRY IN THE CASE OF POLARIZATION OF NUCLEI BY GORTER–ROSE METHOD. Dzhrbashyan, V. A. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 3, 165-172(1972). (In Russian).

The most general formulas of those existing are obtained for the degree of polarization, f_1, by which the beta asymmetry is expressed. The theory is compared with the experiment of Wu et al., where the dependence of asymmetry on the temperature has been observed, in fact, for the particular case of ^{60}Co. The formulas for f_1 which are responsible to within a constant factor for the description of this dependence agree with the results of experiment. (2 figures) (auth)

18834 INVESTIGATION OF THE WIGNER CUSPS IN AN EXACTLY SOLUBLE MODEL. Hari, Josef. ATOMKI (At. Kut. Intez.) Kozlem.; 14: No. 3, 197-231(1972). (In Hungarian).

Threshold anomalies were investigated in an exactly soluble coupled three-channel model. Square wells represent the heavy particles and surface δ potentials give rise to the coupling. The numerical results presented were derived for $l = 0$. The following conclusions are reached: the behavior of the threshold anomalies appearing in the scattering, "reaction", and total cross section around the threshold of the opening channel is in a good accordance with the theoretical results of Wigner, Baz, and Fonda, obtained with an approximate treatment; the final-state coupling might strengthen and broaden the anomaly; the position of the optical resonance, present in the scattering and/or reaction channel, strongly influences the size of the anomaly. (15 figures, 1 table) (auth)

18835 HIGH-ENERGY SCATTERING OF HADRONS FROM ATOMIC NUCLEI. Lesniak, Leonard. Zesz. Nauk. Uniw. Jagiellon., No. 263, Pr. Fiz.; No. 9, 7-71(1971). (In Polish).

High-energy scattering of hadrons by nuclei is described in the framework of the multiple collision model formulated by Glauber. The basic assumption of this model is that the phase shift corresponding to the scattering of the incident hadron by the nucleus is the sum of the phase shifts caused by the nucleons inside the nucleus. In this paper experimental data for the scattering of high-energy electrons and protons from various light, medium, and heavy nuclei are explained. The amplitude for the scattering of hadrons from nuclei is constructed, its general properties are discussed, and the cross section formulas are derived. At first these formulas are applied to the elastic scattering of 1-GeV protons and electrons by ^{4}He. The influence of the ratio of the real to imaginary part of the hadron–nucleon amplitude is found to be very important. A hypothesis explaining the behavior of the elastic ^{4}He form factor at large momentum transfers is presented together with numerical calculations, and the problem of the determination of the short-range correlations inside the nucleus is analyzed. Next, the differential and total cross sections for p-shell nuclei are calculated and compared with experiment. Very good agreement is found, especially for scattering by ^{16}O. The influence of the Pauli corrections on the elastic scattering is small. In these calculations no free parameters are involved. The angular distribution for the scattering of protons by the deformed ^{12}C nucleus is calculated. For the case of the hadron scattering by medium and heavy nuclei, the so-called optical limit formula is derived and its applicability is confirmed. The importance of the Coulomb interaction of charged hadrons with nuclei is established for elastic scattering from heavy nuclei. The structure of the differential cross section is very sensitive to the Coulomb interaction in the region of diffraction minima. A detailed analysis of the CERN experiment with bad energy resolution on the scattering of 19.3-GeV/c protons by various nuclei is performed, and very good agreement with multiple scattering theory is found. A method for extracting the ratio of the real to imaginary part of hadron–nucleon scattering amplitude based on the scattering of hadrons from heavy nuclei is proposed. (auth)

18836 TOPICS IN NUCLEAR THEORY. Elliott, J. P. (Univ. of Sussex, Brighton, Eng.). pp 61-112 of Topics in Atomic and Nuclear Theory. /Judd, B. R. Christchurch, N. Z.; Univ. of Canterbury (1972).

This set of lectures is in three parts. In the first we review the gross properties of nuclei, the nature of nuclear forces and the shell-model. The second part will describe the importance of symmetry in physics generally and in nuclear physics in particular. The third part will show how the same techniques may be applied to the structure of elementary particles on the quark model. (auth)

18837 TWENTY YEARS OF NUCLEAR RESEARCH AT THE CENTRAL RESEARCH INSTITUTE FOR PHYSICS. Ero, Janos (Central Research Inst. for Physics, Budapest). Fiz. Szemle; 22: No. 9, 257-266(Sep 1972). (In Hungarian).

The work at the Central Research Institute during the past twenty years is summarized in terms of charged-particle reactions, neutrons, interdisciplinary studies, theoretical investigations, and technical developments. (W.D.M.)

18838 THREE-BODY PROBLEM OF NUCLEAR PHYSICS. Lovas, Istvan (Central Research Inst. for Physics, Budapest). Fiz. Szemle; 22: No. 9, 266-274(Sep 1972). (In Hungarian).

Nuclear physics problems, the solution of which requires the study of the three-body problem, such as the nucleon–nucleon interaction, the three-nucleon system, etc, are reviewed. The first problem is based on the assumptions that phenomena of low-energy nuclear physics may be described by nonrelativistic quantum mechanics, and that there is a V potential which can describe satisfactorily two-nucleon interactions, at least at low energies. If the shape of this two-nucleon potential were known, a large portion of the nuclear physics problems could be solved theoretically; unfortunately, this is not the case. Many problems require the use of the three-body methods of quantum mechanics. The careful theoretical treatment of the (d,p) reaction is of great importance but until now this problem was treated on the basis of simplified assumptions. A model that presents solutions on the basis of the Faddeev equations is described; it is under further development, in order to broaden its field of applicability. (TTT)

18839 MEASUREMENT OF THE PERTURBED ANGULAR CORRELATIONS AND ANGULAR DISTRIBUTIONS. Keszthelyi, Lajos (Central Research Inst. for Physics, Budapest). Fiz. Szemle; 22: No. 9, 274-277(Sep 1972). (In Hungarian).

Some properties of matter may be conveniently investigated by determining the interactions between magnetic and electric fields, using methods such as nuclear magnetic and quadrupole resonance and perturbed angular correlation (PAC). The PAC method is based on the fact that of the 2 successive cascade-type γ emissions, the second radiation is emitted by a specially oriented nucleus. Measurement of the angular correlation and distribution always involves oriented nuclei. The direction of the magnetic moment μ and of the quadrupole moment is affected by the interaction of magnetic and electric fields. The superfine magnetic field of the nuclei of impurity atoms was found to be suitable for the determination of μ values. The range of measurements was greatly extended by examining levels reached by Coulomb excitation. At present about 300 μ data are available for the systematic evaluation of nuclear structure. The problem presented by odd nuclei is illustrated by reviewing the Schmidt diagrams of ^{103}Rh and ^{195}Pt. The even–even nuclei in the ground state have no magnetic moment; in about 10 cases μ data were determined at the second or higher excited states; the ^{182}W nucleus was used to illustrate the problem. (TTT)

18840 ISOBAR ANALOG STATES. Zimanyi, Jozsef (Central Research Inst. for Physics, Budapest). Fiz. Szemle; 22: No. 9, 282-286(Sep 1972). (In Hungarian).

The discovery of isobar analog states in 1961 in intermediate and heavy nuclei surprised the physicists because it had been generally assumed that such states could not exist. This apparent contradiction between earlier theory and experimental observations was further examined, considering the isospin of nuclear states and outlining the role of quasielastic or charge exchange reactions, together with their mathematical model. The wave function of isobar analog resonance (IAR) is derived on the basis of the rules governing the isospins. As the structure of IAR is similar to that of the parent analog, information concerning its structure helps to understand the parent state. The IAR structures were determined by studying elastic and inelastic scattering and

the radiation-induced decay of the resonances. The effect of the Lane potential acting between the bombarding particles and the target nuclei is also reviewed, emphasizing particularly the contributions of Hungarian researchers. (Review article, 29 references). (TTT)

18841 BETA-RAYS EMITTED FROM THE POLARIZED NUCLEI AND BETA-DECAY INTERACTIONS ON THE STRONG MESON-DOMINANCE MODEL. Nakamura, S.; (Tokyo Univ.); Sato, S.; Igarashi, M. Progr. Theor. Phys. (Kyoto); 48: No. 6A, 1899-1917(Dec 1972).

As a natural extension of the original Yukawa theory of β-decay, the strong meson-dominance model is presented, in which all strong mesons can in general contribute to β-decay. By assuming that the weak interactions between mesons and leptons are exclusively V-A type, general expressions of the beta-decay interactions are deduced, which agree exactly with those given by Weinberg. Here the main contributions come out from the intermediary acts of mesons, π(140 MeV), ρ(760 MeV), δ(960 MeV), π_N(1016 MeV), A_1(1070 MeV) and B(1220 MeV). The theoretical formulas for the β-ray spectra emitted from the polarized nuclei are given, among which the contributions from the pseudotensor interaction (the second class interaction) coming from the B-meson channel are noticeable, besides those from the tensor interaction (the first-class interaction) coming from the ρ-meson channel. (auth)

18842 BREAKING OF THE SENIORITY SCHEME IN A NEUTRON–PROTON CONFIGURATION J^n. Nomura, M. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6A, 2114-2115(Dec 1972).

It is shown that an effective neutron–proton interaction breaks the seniority scheme of the j^n configuration in such a way that the nuclear collective motions should be much enhanced. (JFP)

18843 NUCLEAR EXCITATION BY THE BOUND MUON AND THE MUONIC HYPERFINE STRUCTURE. Konishi, T. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1569-1580(Nov 1972).

For the even–even transition nuclei a theory of the nuclear quadrupole excitation by the bound muon is formulated using a realistic nuclear wave function on the basis of the anharmonic oscillator model. The hyperfine spectrum of the muonic x ray is predicted for ^{192}Os, and the dependence of the nuclear parameters on the spectrum is also discussed. It is suggested that it is possible to discriminate the nuclear model and to find out some nuclear properties in comparison with more precise measurement of muonic x rays. (2 figures, 1 table) (auth)

18844 ROTATIONAL FLOW FOR THE STUDY OF ROTATIONS OF DEFORMED EVEN–EVEN NUCLEI. Prakash, V. R.; Bahal, B. M.; Deshpande, V. K. (Indian Inst. of Tech., Kanpur). Can. J. Phys.; 50: No. 23, 2957-2960(1 Dec 1972).

The Bohr–Mottelson hydrodynamical model is extended to include rotational flow by assuming a finite constant vorticity throughout the volume of a nucleus. The vorticity is found to vary as β^2 from nucleus to nucleus, thus giving irrotational flow only for spherical nuclei with no rotational spectra. (auth)

18845 INTRODUCTION TO NUCLEAR FISSION. Dietrich, K. (Technische Univ., Munich). J. Phys. (Paris), Colloq.; No. 5, C5.3-C5.15(1972).

Basic observations in the nuclear fission field and their interpretation in terms of a semi-classical phenomenological theory are briefly reviewed. A more complete theoretical treatment is also indicated. (France)

18846 INFLUENCE OF THE NUCLEAR NON-SPHERICITY ON THE DENSITY SPREADING PARAMETER IN ELECTRON SCATTERING EXPERIMENTS. Inopin, E. V.; Antonov, A. N. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1910-1912(Nov 1972). (In Russian).

It is shown that the presence of the degrees of freedom that are connected with the nuclear surface gives an additional effective spread of the surface layer. An expression is obtained determining the spread through the unified model parameters—the deformation parameter in case of the nonspherical nucleus and the zero vibration amplitude in case of the spherical nucleus. (auth)

18847 n–n AND n–p EFFECTIVE INTERACTIONS FOR $1f_{\frac{7}{2}}$ PROTONS AND $(2p,1f_{\frac{7}{2}})$ NEUTRONS. Gmitro, M. (Physics Research Inst., Rez, Czech.); Rimini, A.; Weber, T. Nuovo Cim.; 13A: No. 2, 526-540(21 Jan 1973).

The spectra for ^{58}Ni and ^{56}Co given by the existing phenomenological n–n and n–p effective interactions for neutrons in the $2p_{\frac{3}{2}}$, $1f_{\frac{7}{2}}$ and $2p_{\frac{1}{2}}$ levels and protons in the $1f_{\frac{7}{2}}$ level show large discrepancies with the present experimental spectra. The interactions by Auerbach and Vervier are modified in a simple way in order to take account the new experimental information. The obtained interactions are used to calculate the spectra and ground-state energies of the N = 29 and N = 30 nuclei. For comparing theory and experiment, the experimental spectra of the considered nuclei are analyzed to detect the states which are mainly outside the model space and whose energy cannot be accounted for by the effective interaction. In general, the agreement between the calculated and experimental spectra is quite satisfactory and tends to be better than for Vervier and McGrory calculations. (auth)

18848 RELATIVE STABILITY OF SYSTEMS WITH SINGULAR POTENTIALS. Simenog, I. V. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1916-1918(Nov 1972). (In Russian).

For systems with singular potentials of attraction the representation of independent particles in a Hartree sense is accurately realized in the asymptotic limit $N \to \infty$. It is shown that, for each class of potentials, the self-consistent Hartree field is a boundary problem for the many-particle Schroedinger equation in the asymptotic limit of a large number of particles $N \to \infty$. (KSW)

18849 PARAMETRIZATION OF B(E2)-TRANSITIONS IN DEFORMED EVEN–EVEN NUCLEI IN THE FRAMEWORK OF SU(3) SCHEME. Raichev, P. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 6, 1171-1177 (1972). (In Russian).

A problem on applicability of SU(3) scheme in deformed nuclei is being studied. With the help of free parameters, arising in SU(3) scheme, the transition probabilities are parametrized. The results are compared with experiment. (auth)

18850 CONSTRUCTION OF PHYSICAL BASIS FOR O(5) AND SU(3) GROUPS WITH AUTOMATIC PERFORMANCE OF SYMBOLIC TRANSFORMATIONS. Vinogradov, V. N.; Gai, E. V.; Popov, S. I.; Rabotnov, N. S.; Shchenkov, I. B. Yadern. Fiz.; 16: No. 6, 1178-1187(1972). (In Russian).

Automatic fulfilment of complicated analytical operations based of REFAL language is used to construct physical basis of O(5) and SU(3) group representations. These bases were used in describing quadrupole oscillations of nuclear surface and in the quantum mechanical three-body problem. For O(5) group there has been found an explicit form of the operator corresponding to the extra quantum number, represented as a fourth order polynomial in group generators. For SU(3) group basis there are also derived some matrix elements and overlapping integrals, using the obtained formulae. (auth)

18851 NUCLEAR SPECTROSCOPY IN THE 1f–2p SHELL WITH HEAVY-ION REACTIONS. Lemaire, M. C. (CEN, Saclay, France). pp 43-71 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

Work that pointed out the existence of four-nucleon correlations is briefly reviewed first. Calculations for even–even N = Z nuclei are considered, including calculations with deformed orbits, "exact" shell-model calculations, the alpha-cluster model, and the stretch scheme; these are extended to calculations for N > Z nuclei, and then the experimental investigation of four-nucleon correlations is discussed. Experimental techniques are considered next. Attention is then directed to the reaction mechanism under the topics elastic scattering, selectivity of transfer reactions, energy dependence of the spectra, and angular distributions. The discussion of nuclear spectroscopy with heavy-ion experiments begins with two-proton-transfer reactions, but the emphasis is on the experimental investigation of four-nucleon correlations in medium-weight nuclei by means of alpha-transfer experiments. Experimental evidence for four-nucleon correlations in Ni, Zn, Ti, and Cr isotopes is examined, and theoretical energy spectra of ^{58,60}Ni and ^{62}Zn calculated in the stretch scheme are compared with experimental data. In summary, the (^{16}O, ^{12}C) reaction provides a powerful tool for investigating four-nucleon correlations, and the most striking features of the (^{16}O, ^{12}C) spectra between ^{40}Ca and ^{64}Ni are given. (24 figures, 2 tables) (RWR)

18852 SPIN-ORBIT INTERACTION IN INELASTIC NUCLEON SCATTERING. Raynal, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 75-116 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

The subject is introduced by brief discussions of polarization measurements, inelastic scattering, macroscopic models, and microscopic models; the latter two topics are treated in detail in the rest of the paper. Macroscopic models are the rotational and the vibrational; the former is taken as an example. Coupled-channels calculations in this model are briefly reviewed; then the deformed $\vec{L} \cdot \vec{S}$ coupling is introduced, and its effects are discussed. The treatment of the microscopic description begins

with a presentation of the helicity formalism, including the description of a bound state and two-body interaction, and its application to nuclear reactions. The two-body spin–orbit interaction is considered with respect to finite range, expansion for small ranges, and zero-range limit $\vec{L}\cdot\vec{S}$ interaction. Shell effects are touched on, and various aspects of calculational results are presented, including the two 2^+ states of ^{54}Fe, use of cutoff, and unnatural parity states. (18 figures, 2 tables) (RWR)

18853 UNIFIED THEORY OF NUCLEAR REACTIONS AND BOUND STRUCTURES AND CLUSTER REPRESENTATIONS. Wildermuth, K. (Univ., Tuebingen, Ger.). pp 117-144 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

A discussion of the time-dependent Schroedinger equation introduces the subject. Some special examples are considered which show how the correct boundary conditions are introduced into the ansatz for the wave function of a given reaction process or bound-state problem; these are the scattering of neutrons by α particles and the elastic scattering of deuterons by α particles ($L = 0$). Generalization of the theory and the influence of the Pauli principle are next discussed, followed by the combination of shell-model and other bound-state calculations with cluster reaction calculations (semiquantitative considerations). Finally, some general properties of the unified theory of nuclei are examined. (4 figures) (RWR)

18854 OPTICAL POTENTIAL FOR DEUTERON SCATTERING. Bauer, M. (Universidad Nacional Autonoma de Mexico, Mexico City). pp 145-147 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

The optical potential for the scattering of composite nuclear projectiles is discussed. (1 figure) (auth)

18855 KAPUR–PEIERLS THEORY. Nagarajan, M. A. (Univ., Liege). pp 171-181 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

Attention is directed to the study of the energy and radius dependence of the complex eigenvalues, as well as the suitability of one-level approximation to the S matrix in the analysis of isolated resonances. The first simple model considered is that of the scattering of a particle by a spherical potential. The remainder of the paper is concerned with many-channel calculations. (8 figures) (RWR)

18856 SCATTERING OF HIGH-ENERGY PARTICLES ON LIGHT NUCLEI. Guardiola, R. (International Centre for Theoretical Physics, Trieste, Italy). pp 185-194 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

The elastic and inelastic scattering of high-energy particles by light nuclei is studied by means of Glauber's multiple-scattering theory, in order to obtain information on the structure of the nuclear wave functions. (5 figures) (auth)

18857 HIGH-ENERGY SCATTERING OF HADRONS FROM NUCLEI. Gillespie, J. (Boston Univ.). pp 195-216 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

After a brief introduction, the motivation for studying hadron–nucleus scattering at GeV energies is presented from the points of view of nuclear and particle physics. Interest in this subject stems from new experimental developments. The qualitative ingredients of Glauber theory are briefly summarized. The fundamental approximation underlying models related to Glauber's is the eikonal representation of the two-particle scattering amplitude; the classical origins of eikonal theory are recalled, and then the more interesting method of directionally approximating the Green's function is considered. Multiple scattering and elastic and inelastic scattering are elucidated. The nuclear physics of the theory is contained in the wave functions; they may be analytical expressions with parameters fit to a particular nucleus or they may be numerical, obtained from model calculations. After a consideration of two-particle amplitudes, the final amplitude is assembled, predictions are made with the theory, and these predictions are compared with experiment. "Deuteronomy"—the study of the deuteron and its problems—is treated, and problems of interest for the future are suggested. (8 figures) (RWR)

18858 HIGH-ENERGY SCATTERING OF ELECTRONS FROM NUCLEI. Ciofi Degli Atti, C. (Istituto Superiore di Sanita, Rome). pp 217-254 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

After a historical introduction, the fundamentals of electron scattering are presented: kinematics, energy spectra, and angular distributions; cross section in Born approximation; selection rules and contribution of longitudinal and transverse scattering; and corrections to the first Born approximation. Recent results on electron elastic and quasi-elastic scattering at high energy and momentum transfers and attempts to interpret them from the point of view of nuclear structure are reviewed. Elastic electron scattering and single-particle wave functions and elastic electron scattering and Jastrow correlations are discussed. This is followed by consideration of quasi-elastic scattering, a direct knock-out of the bound nucleons by the incident particle, occurring at high energy and momentum transfers; kinematics and cross sections, noncoincidence quasi-elastic scattering, and coincidence quasi-elastic scattering are included. The usefulness of these experiments for elucidating nuclear models is examined. (21 figures, 3 tables) (RWR)

18859 THEORY OF EFFECTIVE INTERACTIONS. Kirson, M. W. (Weizmann Inst. of Science, Rehovot, Israel). pp 257-285 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

The many-body perturbation theory approach to the theory of effective interactions is discussed in some detail. The emphasis is on the relative importance of various effects rather than on agreement with experiment. (18 figures, 5 tables) (auth)

18860 HARTREE–FOCK THEORY OF FINITE NUCLEI IN THE LOCAL DENSITY APPROXIMATION. Nemeth, J. (Eoetvoes Lorand Univ., Budapest). pp 287-306 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

Although Brueckner–Goldstone theory has been used in the past for both nuclear matter and nuclei, it is more convenient for nuclear calculations to use an effective interaction instead of the G operator. A definition of an effective interaction in nuclear matter is formulated, and this is followed by a definition of effective forces in finite nuclei. Renormalization and the starting-energy corrections are discussed, along with the separation of volume and residual surface terms of potential energy. Hartree–Fock equations with density-dependent forces are considered, and results with different density-dependent effective forces are tabulated. (1 table) (RWR)

18861 MICROSCOPIC DESCRIPTION OF THE 2p–1f SHELL NUCLEI. Rimini, A. (Univ., Trieste, Italy). pp 309-318 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

The construction is described, from a smooth nucleon–nucleon interaction, of an effective Hamiltonian suitable for shell-model calculations in the complete 2p–1f shell of ^{56}Ni and neighboring nuclei. A preliminary application to ^{56}Ni is made by using a 2p–2h approximation. (4 figures, 4 tables) (auth)

18862 NUMBER-CONSERVING QUASI-PARTICLE CALCULATIONS. Weber, T. (Univ., Trieste, Italy). pp 319-327 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

The physical grounds and main features of the broken pair approximation (BPA) are presented. This formalism is introduced as a number-conserving approximation to the lowest-seniority shell model, and is applied to the nickel isotopes by using a phenomenological interaction and a realistic interaction. Comparison with the lowest-seniority and the exact-shell-model results shows that the BPA is a much more reliable approximation than the quasi-particle Tamm–Dancoff approximation. (2 tables) (auth)

18863 ANHARMONICITIES AND THE PARTICLE–VIBRATION COUPLING. Sips, L. (Inst. Rudjer Boskovic, Zagreb). pp 339-355 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).
See STI/PUB-305.

After a short introductory passage about the insufficiency of the harmonic description, the phenomenological description of nuclear vibrations is briefly reviewed and the geometrical structure of the anharmonicities is shown. The concept of particle–vibration coupling and its relevance to the problem of anharmonicities is then discussed. Finally, triangular graphs are shown to give the possibility of evaluating the magnitude of the third-order anharmonicities, and an explicit calculation of the quadrupole moments of the isotopes of Cd is presented. (6 figures, 2 tables) (RWR)

18864 QUASI-PARTICLE VIBRATION COUPLING. Rybarska, W. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 357-372 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

A complete system of coupled equations necessary for describing the nuclear nonrotational excitation is obtained from a variational principle without use of the equations of motion. (1 figure) (RWR)

18865 NUCLEAR FISSION. Dietrich, K. (Univ., Heidelberg). pp 373-399 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

After a historical introduction concerning the various models that have been used to describe the fission process, a classical Hamiltonian function for fission is derived in the cranking approximation; some comments on the quantization problem are offered. Next, the "Strutinsky method" is developed in some detail, with a view toward its application. The qualitative effect of the shell-correction term is discussed, and specific forms of phenomenological nuclear-shell-model potentials for strongly deformed nuclei are mentioned. Finally, a number of important unresolved problems are listed. (7 figures) (RWR)

18866 QUADRUPOLE COUPLING CONSTANT FOR LARGE DEFORMATIONS. Zielinska-Pfabe, M. (Inst. for Nuclear Research, Warsaw); Bochnacki, Z.; Gabrakov, S. pp 401-409 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

The channel theory of fission and the problem of choosing an effective two-body interaction are considered in the introduction. The determination of the quadrupole force strength from the position of 0^+ and 2^+ vibrational states of deformed nuclei by using the Nilsson-model potential is then discussed. Next, the effective two-body force is calculated directly from a given single-particle potential; the deformation dependence of the multipole–multipole interaction is discussed, and the results obtained by both methods are compared. Finally, the calculated values of the strength of the nonaxial quadrupole force are used in estimating the position of the γ-vibrational state for large deformation (for the saddle point and in the second potential-energy well). (1 figure, 2 tables) (RWD)

18867 JASTROW CORRELATIONS: DIAGRAMMATIC EXPANSIONS. Ripka, G. (International Centre for Theoretical Physics, Trieste, Italy). pp 413-438 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

A perturbation expansion of the expectation value of one- and two-body operators calculated with a Jastrow wave function is developed in terms of linked diagrams, and some of the applications of Jastrow wave functions that have been made in nuclei are discussed. After an introduction concerning the use of Jastrow wave functions, the Jastrow wave function and one- and two-body correlation functions are defined. Calculation of the normalization constant is then addressed, including the expansion of the product of correlation factors, expansion of the squared Slater determinant, and exponential formula for the normalization constant C_N, and concluding with an example. Calculation of the one-body correlation function is discussed, including expansion of the correlation factors, expansion of the determinant and rules for calculating $G_1(\vec{r}_1, \vec{r}_1')$, and rules for calculating the density. After considering the two-body correlation function, the paper concludes by discussing the effect of Jastrow correlations on the charge density of ^{40}Ca. (13 figures) (RWR)

18868 VARIATIONAL DETERMINATION OF THE EFFECTIVE INTERACTION IN NUCLEI. Grypeos, M. E. (Democritus Nuclear Research Center, Athens). pp 439-454 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

After setting the stage briefly in the introduction, the author discusses the unitary model operator and the effective nuclear Hamiltonian of Villars. Most of the paper is devoted to describing two cluster-expansion variational methods for determining the two-nucleon relative wave functions and the matrix elements of the effective interaction. The variational method with the separation condition is discussed first, along with the continuity of the derivative of ψ_{nlS} at the separation distance. The variational method with the healing condition is taken up next, and it is extended to cover the case of noncentral forces. Certain applications of the matrix elements of the effective interaction determined above are mentioned; these include the ground-state energy of ^{16}O and the charge form factor of ^{4}He. (4 figures, 1 table) (RWR)

18869 STATIC MAGNETIC INTERACTION AND NUCLEAR MAGNETIC MOMENTS. Ogaza, S. (Inst. of Nuclear Physics, Krakow). pp 565-587 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

Appropriate definitions are presented in an introduction. The subject of nuclear magnetic dipole moments is then discussed at some length, and this is followed by a brief review of the topic of hyperfine magnetic fields. The paper concludes with discussions of a few of the hyperfine field mechanisms that are suggested by iron-host data, including conduction electron polarization, core polarization and localized moments, and mechanisms for rare earth solutes and the $d^{10}s^2p^n$ solutes. (11 figures, 1 table) (RWR)

18870 ADVANCES IN NUCLEAR PHYSICS. VOLUME 4. Baranger, M.; Vogt, E. (eds.). New York; Plenum Publishing Corporation (1971). 463p. $20.00.

Separate abstracts were prepared for the six chapters presented. (WDM)

For abstracts of individual chapters see: 18076, 18077, 18683, 18735, 18871, and 18872.

18871 INVESTIGATION OF HOLE STATES IN NUCLEI BY MEANS OF KNOCKOUT AND RELATED REACTIONS. Jackson, D. F. (Univ. of Surrey, Guildford, Eng.). Advan. Nucl. Phys.; 4: 1-60(1971).

Emphasis is on knockout reactions although many other processes, including transfer reactions, are mentioned in order to illustrate the relationship between the various reactions which give information on hole states. (WDM)

18872 HIGH-ENERGY SCATTERING FROM NUCLEI. Czyz, Wieslaw (Inst. of Nuclear Physics, Krakow). Advan. Nucl. Phys.; 4: 61-131(1971).

The diffractive multiple-scattering model (Glauber model) is developed in a simple form, and the existing experimental evidence for this model is discussed. Following this comes extensions, applications to fields of physics other than nuclear, prospects of future applications, and a very modest discussion of the applicability limits of the model. (WDM)

PHYSICS (PLASMA AND THERMONUCLEAR)

18873 PLASMA PHYSICS INDEX. Vol. 7, No. 10, 1972. Bibliography, author index, subject index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie–Dokumentation (1972). 173p.

This listing contains 386 references on various aspects of plasma physics. (MOW)

18874 PLASMA PHYSICS INDEX. Volume 7, No. 12, 1972. Bibliography, author index, subject index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie–Dokumentation (1972). 157p.

This listing contains 288 references on various aspects of plasma physics. (MOW)

Confinement and Heating

Refer also to abstract 18917.

18875 (CLM-R-112) NEUTRAL INJECTION HEATING OF TOROIDAL REACTORS. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.). Jul 1971. 141p. Dep. NTIS (U. S. Sales Only). UK 2.50 pound.

The major constraints that decide the basic parameters of injection are described. The technological constraints that decide the design of the unit are discussed stage by stage and, where appropriate, attention is drawn to the areas requiring further work. Some physical processes in the resulting plasma are then discussed. (MOW)

18876 (COO-2194-1) PROPOSAL TO STUDY ION RESONANCE HEATING OF PLASMA. Final Report, January 1–December 31, 1972. Korn, P.; Wharton, C. B. (Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies). [nd]. Contract AT(11-1)-2194. 31p. Dep. NTIS.

The mechanism responsible for rf plasma heating in the Cornell turbulently preheated mirror machine has been identified as fundamental and harmonic resonant ion cyclotron heating. Observation of the neutral atom flux emitted from a localized region of plasma using a highly directional detector shows the heating to be sharply resonant with magnetic field and occurring well outside the near field of the antenna. Experiments on microwave scattering from the plasma waves also show the resonant behavior with significant increases in fluctuation level at twice the driving rf frequency for long wavelengths ($\lambda \sim 13$ mm). This is highly suggestive of an electrostatic heating mechanism in the resonance region. A detailed investigation of the energy balance determined that the plasma diamagnetism increases linearly with rf power up to 1 MW, with no saturation effects evident. The heating efficiency is at least 22% with a maximum upper limit of $\lesssim 80\%$, and the total plasma temperature is in the range $310 < (T_e + T_i) < 380$ eV for densities of $2 - 3 \times 10^{13}/cm^3$. The ion energy distribution was non-Maxwellian with a low temperature component $T_i \sim 320$ eV and a high temperature component $T_i \gtrsim 1800$ eV. Thus a significant fraction of the total plasma energy resides with the ions, a situation most favorable for controlled nuclear fusion devices. (auth)

18877 (JUL-882-MA) DIFFUSION OF A COLLISIONLESS PLASMA IN FREE SPACE. A SIMULATION MODEL. Walther, H. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut Fuer Angewandte Mathematik). Aug 1972. 27p. (In German). Dep. NTIS (U.S. Sales Only).

The simulation model deals with a plasma sphere under the influence of the self-consistent electric field only, which means spherical symmetry is maintained and the magnetic field vanishes. This situation is very similar to the process of laser pulse action on liquid droplets. The initial plasma sphere has a radius of about $20\,\lambda_D$ and consists of n/2 electrons, n/4 light and n/4 heavy ions, all in a Maxwellian distribution with respect to mean kinetic energy. During expansion the electrons transfer their kinetic energy via light ions onto the heavy ones (by boundary fields) until a quasi-stationary state is reached. (GF)

18878 (UCRL-74445) NUCLEAR FUSION BY MAGNETIC CONFINEMENT. Post, R.F. (California Univ., Livermore. Lawrence Livermore Lab). 16 Jan 1973. 11p. (CONF-730306-1). Dep. NTIS. From International Convention and Exhibition of the IEEE Meeting; New York, New York, United States of America (USA) (26 Mar 1973).

The concept of a nuclear fusion reactor based on magnetic confinement is becoming scientifically credible, following two decades of research devoted to the solution of complex problems in plasma physics. Barring setbacks, current research programs surveyed in this paper could lead to demonstrations of scientific feasibility within a decade. Although the present research is concentrated on the confinement problem, increasing consideration is being given to the engineering and technology problems expected to arise in the design of fusion reactors based on the three main present approaches to the fusion confinement problem. These approaches are: 1) closed or toroidal systems of the "tokamak" type, 2) pulsed high-density systems called "theta pinches", and 3) open-ended magnetic configurations utilizing the magnetic-mirror principle for plasma confinement. The status, remaining problems, and potential as a reactor of each of the above approaches are discussed. (auth)

18879 THEORY OF ELECTRON CYCLOTRON RESONANCE HEATING. I. SHORT TIME AND ADIABATIC EFFECTS. Jaeger, F.; Lichtenberg, A. J.; Lieberman, M. A. (Univ. of California, Berkeley). Plasma Phys.; 14: No. 12, 1073-1100(Dec 1972).

The theory of single-particle electron cyclotron resonance heating in a magnetic mirror is treated analytically and numerically, using the techniques of integration of the Lorentz force equation and transformation to a Hamiltonian approximation, to study both short time scale and adiabatic effects. The force equation is analytically integrated in the vicinity of the resonance plane to obtain the energy dependence of the effective time spent in resonance per bounce. Electron heating is limited by the existence of invariants at high energies, which present adiabatic barriers to the heating. The calculation of the barrier location is considered in a Hamiltonian theory of electron cyclotron heating, using the technique of resonance breakdown of adiabatic invariance due to secondary island formation. It is found that resonance between the fifth harmonic of the energy oscillation and the half-bounce period (appearance of five islands) is sufficient to destroy the invariant. (auth)

18880 TURBULENT PLASMA DIFFUSION IN VELOCITY SPACE. Bugnolo, D. S. (Univ. of Quebec). Phys. Lett.; 42A: No. 7, 487-489(29 Jan 1973).

The concept of turbulent diffusion in positional space, which has been used by the author and others for the study of turbulent plasma, was generalized to include the effects of diffusion in velocity space. (auth)

18881 ELECTRON HEATING IN A SINGLE-ENDED Q MACHINE BY R.F. POWER. Christoffersen, G. B.; Prahm, L. P. (Danish Atomic Energy Commission, Risoe). Plasma Phys.; 14: No. 12, 1140-1144(Dec 1972).

The optimal heating frequency was found to be proportional to the electron-plasma frequency and to vary inversely with the distance between the hot plate and the exciting grid. Assuming excitation of a standing electron wave, the results are in accordance with the dispersion relation for a finite plasma column, the heating being caused by collisionless damping of the electron wave. (UK)

18882 ESTIMATES OF DENSE PLASMA HEATING BY STABLE INTENSE ELECTRON BEAMS. Guillory, J. (Physics International Co., San Leandro, CA); Bedford, G. Plasma Phys.; 14: No. 12, 1131-1138(Dec 1972).

The temperature- and current-dependence of the electron–ion mode is reviewed and a simple model resistivity is used to estimate attainable electron temperatures. For beams in the 100 nsec 10 kA/cm^2 range, the heating is by ion-acoustic oscillations, and if convective losses are prevented, keV temperatures can be expected in moderately dense (10^{14} cm^{-3}) plasma. (auth)

18883 CURRENT-DRIVEN TURBULENT HEATING OF A PLASMA IN A MAGNETIC FIELD. Burchenko, P. Ya.; Volkov, E. D.; Manzyuk, N. A.; Suprunenko, V. A.; Sukhomlin, A. A. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 7, 1232-3(Jan 1973). Translated from Zh. Tekh. Fiz.; 42: No. 7, 1540-1(Jul 1972).

Stabilization of the velocity associated with current flow in a plasma in longitudinal electric and magnetic fields was investigated in the high-current linear discharge in the Grom device and in the Sirius stellarator. It is shown that the ratio of electron drift velocity to thermal velocity in turbulent heating is a function of the ratio of electron cyclotron frequency to electron plasma frequency. (auth)

Diagnostics

Refer also to abstract 18934.

18884 (MATT-952) PNEUMATIC-OPERATED DIAGNOSTIC AND OTHER DEVICES. Christie, R. S. (Princeton Univ., N. J.

Plasma Physics Lab.). Jan 1973. Contract AT(11-1)-3073. 15p. Dep. NTIS.

In the study of plasmas in the FM-1 Machine at PPL it has become increasingly desirable to make diagnostic measurements with a minimum of disturbance to the plasma, especially since the plasma confinement time has been improved. The probe must be small, and must be inserted and withdrawn quickly, or must be timed precisely with respect to overall time of the experiment being conducted. Pneumatic-actuated mechanisms are being used frequently as a means to this end. The latest designs of pneumatic-probe mechanisms and other devices and systems employed in the FM-1 at PPL are described as well as their operation and operating characteristics. (auth)

18885 DETERMINATION OF THE DENSITY OF CHARGED PARTICLES IN A NONEQUILIBRIUM LOW-DENSITY PLASMA FROM THE CHARACTERISTIC OF A LANGMUIR PROBE. Shuvalov, V. A. (Inst. of Mechanics, Dnepropetrovsk, USSR). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 570-571(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 642-643(1972).

The present investigation was undertaken to establish whether reliable data can be obtained on the density of charged particles in a plasma at rest from the current–voltage characteristic of an isolated Langmuir probe for which $R/\lambda_D < 1$. (R is the probe radius and λ_D the Debye radius.) Experiments were made in the nonisothermal plasma of a high-frequency (7 MHz) discharge in helium at the pressures 0.07, 0.12, and 0.20 mm Hg. The isolated cylindrical probe was the thermoanemometer with heated molybdenum wire of diameter 0.09 mm and length 17 mm. The wire was set up at a distance of 2 mm from the section of the external electrode of the plasmatron, the plasma source. To avoid random errors, the probe characteristics were measured for both increasing and decreasing voltages. The probe temperature was varied from 380 to 600°K, to guarantee the absence of appreciable layers of adsorbed gases on the surface. (auth)

18886 PLASMA DIAGNOSTICS OF A PULSED HYDROGEN DISCHARGE. III. Borodin, V. S.; Gebekov, V. B.; Kagan, Yu. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 1, 15-16(Jul 1972).

Translated from Opt. Spektrosk.; 33: No. 1, 29-31(Jul 1972).

The feasibility of determining the electron concentration from the Hβ line profile integrated along the radius is studied. The experimental data obtained at pressures of 200 mm and 430 mm confirm the possibility of determining the concentration at the axis and the variation in the electron concentration along the discharge radius from the measured half-width of the integrated profile of the Hβ line, which is taken along the diameter in the line of sight and from the relative variation in intensity along the radius. (auth)

18887 SCATTERING OF LIGHT BY THE ELECTRONS OF A HIGH-TEMPERATURE PLASMA. Zhuravlev, V. A.; Petrov, G. D. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 1, 19-21(Jul 1972).

Translated from Opt. Spektrosk.; 33: No. 1, 36-41(Jul 1972).

Scattering of light by the electrons of a relativistic plasma is considered in the absence of collective interactions. Approximate expressions that describe in a number of cases the spectral composition and the indicatrix of scattered radiation are obtained under the assumptions of the paper. (auth)

18888 EFFECTS OF NON-MAXWELLIAN ELECTRON ENERGY DISTRIBUTIONS ON THE ORBITAL LIMITED CURRENT-VOLTAGE CHARACTERISTICS OF CYLINDRICAL AND SPHERICAL LANGMUIR PROBES UNDER COLLISIONLESS CONDITIONS. Polychronopulos, B. (Univ. of Birmingham, Eng.). Plasma Phys.; 15: No. 1, 37-48(Jan 1973).

A unified theory for idealized spherical and cylindrical probes, operated under orbital limited conditions in the electron accelerating region, is presented which permits a detailed examination of the effects of non-Maxwellian electron energy distributions on the current–voltage characteristics of such probes. It is shown that the electron density values derived from the accelerating region of a cylindrical probe are virtually independent of the electron energy distribution for large probe voltages, while the electron "temperature" values derived from the accelerating region of a spherical probe are only weakly dependent on the precise form of the electron energy distribution. (auth)

18889 X-RAY TEMPERATURE MEASUREMENTS OF LASER-PRODUCED PLASMAS IN LARGE RADIATION FIELDS. Pert, G. J. (Univ. of Hull, Eng.). Phys. Lett.; 42A: No. 7, 511-512 (29 Jan 1973).

The modification to the emitted x-ray signal from a laser-produced plasma due to the change in the electron collisional behavior resulting from the classical electron oscillation is calculated. It is shown that although the total emitted flux may be substantially increased, two foil measurements of temperature should not be greatly in error. (auth)

18890 MEASUREMENT OF TEMPERATURE BY RECORDING THE ABSOLUTE LINE INTENSITY WITH APPARENT INCREASE OF PLASMA OPTICAL THICKNESS. Suckewer, S. (Inst. of Nuclear Research, Warsaw). Plasma Phys.; 14: No. 12, 1144-1147(Dec 1972).

A method using two parallel mirrors is described in which one mirror is rotated for a short period. It is shown that the deformation of the line contours is large so that the conditions for temperature measurement for the reversal and absolute intensity reading method are considerably improved. (UK)

18891 SIMPLE DEVICE FOR MEASURING DOUBLE LANGMUIR PROBE CHARACTERISTICS IN PERIODICALLY PULSED DISCHARGES. Datlov, J.; Kryska, L. Cesk. Cas. Fys.; 23 No. 1, 55-56(1973). (In Czech).

A simple device for rapid measurement of the plasma characteristics by the double Langmuir probe method in pulsed discharges is described. The voltage is changed by means of slow rotation of the system. (auth)

Kinetics (General)

18892 (IPP-IV–44) STOCHASTIC ACCELERATION. A review. Puri, S. (Max-Planck-Institut Fuer Plasmaphysik, Garching (West Germany)). Sep 1972. 56p. Dep. NTIS (U. S. Sales Only).

The motion of charged particles in externally applied (or otherwise specified) random electric fields is reviewed. Several existing results on stochastic acceleration are rederived as simple consequences of the random-walk process in velocity space. Experimental evidence as well as the possibility of using stochastic heating for thermonuclear ignition is discussed. (auth)

18893 (TRITA-EPP-71-56) ANNUAL REPORT 1971. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 1971. 42p. (In Swedish). Dep. NTIS (U. S. Sales Only).

The activity has been directed towards the following areas: (1) confinement and heating of plasma in the magnetic field of a ring current, (2) collision between moving plasma and obstacles, (3) experiments with plasma in a very inhomogeneous magnetic field, (4) space physics, (5) cosmology and cosmogony, (6) study of electric arcs at atmospheric pressure, (7) study of low-pressure mercury arcs at high current densities, and (8) electron accelerator development. (auth)

18894 (TRITA-EPP-71-57) REPORTS FROM THE DEPARTMENTS OF ELECTRON- AND PLASMA PHYSICS. Index and Abstracts, 1971. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Mar 1972. 20p. INIS.

Reports published at the Departments of Electron Physics, Plasma Physics, and Plasma Physics with Fusion Research in the year 1971 are listed, and abstracts are quoted for every paper. For reports published elsewhere, the journal of publication is given. (Sweden)

18895 STIMULATED EMISSION IN THE FAR VACUUM ULTRAVIOLET IN THE QUICK HEATING OF PLASMA ELECTRONS BY ULTRASHORT LIGHT PULSES. Knyazev, I. N.; Letokhov, V. S. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 1, 59-61 (Jul 1972).

Translated from Opt. Spektrosk.; 33: No. 1, 110-114(Jul 1972).

Consideration is given to the inversion of population in short-wavelength transitions accompanying the quick heating of electrons during the propagation of ultrashort laser pulses in a previously existing plasma. It is demonstrated that it is possible by this means of excitation to obtain an amplification factor of ~10 to 10^3 cm^{-1} in transitions of multiply charged ions in the ~500 Å region. The time required for the inversion to occur is $\sim 10^{-11}$ sec. (auth)

18896 THERMOMAGNETIC EFFECT IN PLASMA LOCATED IN AN INHOMOGENEOUS MAGNETIC FIELD. Lobov, G. D.; Shtykov, V. V. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 6, 959-963(Jun 1972).

Translated from Radiotekh. Elektron.; 17: No. 6, 1234-1240 (Jun 1972).

The effect of appearance of a constant current in a plasma located in an inhomogeneous magnetic field and under the action of a microwave field is discussed. A theory of this phenomenon is proposed. Relations which take into account inhomogeneity of the magnetic field and inhomogeneity of the electric field of the microwave oscillations are obtained. The conducted experiments corroborate the main results of the proposed theoretical model. (auth)

18897 ION ACCELERATION IN A BOUNDARY LAYER OF PLASMA FORMED BY TWO GROUPS OF ELECTRONS. Komkov, V. S.; Pateyuk, G. M.; Chernoivan, A. A.; Khorsun, T. V. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 111-113(1972). (In Russian).

The acceleration of ions in a double electric layer of plasma was studied during its formation by an electrode with a high negative potential. The Poisson equation was used with an assumed potential in an accelerating interval in a plane geometry. It is shown that, in discharges with a double electric layer, it is possible to attain high initial ion energies, promoting both an increase in the density of ion current from the source and an improvement in the conditions for beam focusing in an ion-optic system. (KSW)

18898 STRUCTURE OF ALTERNATING MAGNETIC FIELD IN A NONEQUILIBRIUM GAS-DISCHARGE PLASMA. Liberman, M. A.; Rakhimov, A. T. (Moscow State Univ.). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 427-431(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 481-485(1972).

The structure of an electromagnetic field of frequency ω in a weakly ionized gas-discharge plasma is considered under the condition that the electromagnetic-field frequency exceeds the frequency of the collisions of the electrons with the atoms or molecules of the gas, but is lower than the plasma frequency. It is shown that, under conditions when the alternating electric field influences the ionization balance in the plasma, the depth of penetration of the field into the discharge greatly exceeds c/ω_{pR}, where ω_{pR} is the electron plasma frequency established at the plasma boundary under the influence of the field of the electromagnetic wave. (auth)

18899 INVESTIGATION OF THE STRUCTURE OF A HIGH-CURRENT DISCHARGE IN A LITHIUM PLASMA. Nikolaev, F. A.; Rozanov, V. B.; Sviridenko, Yu. P. (Lebedev Inst. of Physics, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 432-435 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 486-490(1972).

The distribution of the parameters of the plasma of a high-current discharge in lithium is determined by making local measurements of the magnetic field induction distribution. It is shown that the current density, pressure, and temperature of the plasma reach maximum values on the discharge axis and decrease steeply towards the periphery, while the character of the radial dependence of their distribution depends little on the time. Except for the initial stage (0 to 25 μsec), the discharge is quasi-stationary, and the gas-kinetic pressure of the plasma is balanced by the electrodynamic forces. (auth)

18900 RADIATION OF CHARGED PARTICLE UNIFORMLY MOVING IN TIME-DEPENDENT MAGNETOACTIVE PLASMA. Barsukov, K. A.; Lizogub, P. P. (Moscow State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 1, 18-23(1972). (In Russian).

The problem of the radiation of charged particle moving uniformly through an electron plasma with an applied external harmonic-in-time uniform magnetic field is considered with the help of the successive-approximation method. (auth)

18901 CURRENT NEAR THE INSULATOR WALL IN PLASMA ACCELERATORS. Jelen, J. (Ceska Vysoke Uceni Technicke, Podebrady, Czech.). Plasma Phys.; 14: No. 12, 1117-1123 (Dec 1972).

A model of plasma acceleration taking into account the erosion of an insulator wall at the base of the accelerator is studied. The total current is considered as divided into two parts: the propagating head current and a stationary arc near the insulator wall. While a reverse current appears at the base of the accelerator during the second quarter-period, the current in the front flows in the initial direction even after the half-period of the total current. Separated blobs of impurities are created. Dependences of both currents and velocity on the circuit and accelerator parameters are investigated. The results are in agreement with experiments. (auth)

18902 SCATTERING OF LASER LIGHT FROM A MARGINALLY STABLE HYDROGEN PLASMA. Infeld, E.; Skorupski, A.; Zakowicz, W. (Inst. of Nuclear Research, Warsaw). Plasma Phys.; 14: No. 12, 1125-1130(Dec 1972).

Difficulties in interpreting results of laser light scattering experiments involving marginally stable hydrogen plasma are resolved by a solution giving an exact division of parameter space into stable and unstable regions. A numerical method for the exact solution to the problem of marginal stability for any plasma is briefly outlined. An error often made in calculating the scattered spectrum near marginal stability for any plasma is briefly outlined. An error often made in calculating the scattered spectrum near marginal stability is pointed out. (UK)

18903 INFLUENCE OF ELECTRICAL DISCHARGES ON THE SIZE OF HYDROGEN CLUSTERS. Klingelhoefer, R.; Moser, H. O. (Kernforschungszentrum, Karlsruhe, Ger.). Plasma Phys.; 14: No. 12, 1139-1140(Dec 1972).

The influences of an electrical discharge on cluster size has been investigated by means of the scattering of laser light, measuring the angular dependence of the intensity of the scattered light. The cluster beam was passed through circular apertures in two aluminum electrodes which are electrically connected to a capacitor. Electrical breakdown was achieved by injecting electrons into the cluster beam through an aperture in the upper electrode, held at ground potential. During the discharge a giant pulse ruby laser, whose beam is focused on to the cluster beam, is fired at different times, thus giving the time dependence of the scattered angles. The intensities of both incident and scattered light are measured by photomultipliers. From these measurements it is shown that an appreciable amount of the cluster beam exists in cluster form during the discharge. (UK)

18904 EXPERIMENTAL STUDY OF AN ARC DEFORMATION AND CUTOFF MODEL IN A TRANSVERSE MAGNETIC FIELD. Kovalev, I. M. Magn. Gidrodin.; No. 2, 151-154(1972). (In Russian).

Following up on previous studies of plasma jets and arcs which revealed axial and radial anisotropic behavior, experimental studies were carried out by high-speed kinetography and synchronous oscillographic techniques on arcs, determining the effect of the arcs, current and voltage variations. It was found that if the external supply sources remain unchanged, cut-off of the arc in a transverse magnetic field is determined by the transformation of the plasma arc flow. The results revealed that inasmuch as the cut-off of the arc is a local phenomenon, indicated by the radial and axial anisotropy of the arc streams, the arc cut-off velocity in the transverse field exceeds considerably the axially-symmetric cut-off velocity. Both in the magnetic and in the axially symmetric arc cut-off events, the plasma streams conserve their existence after the current has been completely shut off. (TTT)

18905 EXPERIMENTS IN GASDYNAMICS OF EXPLOSIONS. Oppenheim, A. K. (Univ. of California, Berkeley); Soloukhin, R. I. Annu. Rev. Fluid Mech.; 5: 31-58 (1973).

A review is given of investigations of detonation phenomena, shock-wave research, and blast-wave studies. The review mainly discusses chemically reacting media. Some data are described. (MOW)

Kinetics (Experimental)

18906 (COO-2233-1) EXPERIMENTAL RESEARCH ON HIGH β PLASMA. Technical progress report, May 1, 1972-April 30, 1973. Gross, R. A. (Columbia Univ., New York). 15 Jan 1973. Contract AT(11-1)-2233. 5p. Dep. NTIS.

Three research topics on high-β, hot, dense plasmas are being studied experimentally, namely: (1) study by laser-scattering techniques of the temperature and density distributions of the shock-wave-heated plasma in the Columbia high-energy shock tube; (2) study of the rate of energy transfer between a hot, dense plasma containing a strong magnetic field and a cold metallic wall in the Columbia high-energy shock tube; and (3) study of the absorption and scattering of 10.6-μ(CO_2 laser) radiation from a hot, dense plasma created by a plasma focus device. (auth)

18907 SIMULTANEOUS SUPPRESSION OF AN ELECTRON PLASMA WAVE AND AN ION ACOUSTIC WAVE BY BEAM MODULATION. Tsuru, T.; Itakura, A.; Kojima, S. (Tokyo Univ. of Education). J. Phys. Soc. Jap.; 34: No. 1, 189-92(Jan 1973).

An electron plasma wave of an axial mode and an ion acoustic wave of a radial mode were spontaneously excited in a beam-plasma system. By applying the density modulation to the beam at the frequency near to that of the electron plasma wave, the electron plasma wave and the ion acoustic wave faded out simultaneously. Suppression phenomenon of electron plasma wave is now well explained. Simultaneous suppression of the ion acoustic wave implies that this wave is originated from the electron plasma wave. (auth)

Kinetics (Theoretical)

18908 (COO-2059-17) PLASMA SIMULATION WITH FEW PARTICLES. Knorr, G. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Dec 1972. Contract AT(11-1)-2059. 38p. Dep. NTIS.

A numerical method of plasma simulation is described that allows one to simulate Vlasov plasmas with very few degrees of freedom. Linear effects can be simulated by an amount of information corresponding to less than 100 particles; nonlinear effects require less than 500 "particles" in one spatial and one velocity dimension. The method is based on replacing the infinite real eigenvalue spectrum of the free-streaming terms of the

Vlasov equation by a finite discrete spectrum. An imaginary damping term is artificially added to the eigenvalues and thus recurrence effects are minimized. (auth)

18909 (N-72-28743) RESEARCH ON PLASMA TURBULENCE INVOLVING BINARY PARTICLE COLLISIONS AND COLLECTIVE EFFECTS. Final Report. Sandri, G. (Aeronautical Research Associates of Princeton, Inc., N. J.). May 1972. NASw-2352. 50p. (NASA-CR-127479). NTIS.

Plasmas in which binary collisions are important are studied by means of nonadiabatic methods. Two- and three-body correlations are calculated to determine the one-particle distribution for the ionization model. The general dispersion analysis is summarized, and examples of the ionization model and of the static fluctuations are discussed. (auth)

18910 (SC-DR-720733) ALTERNATING-DIRECTION IMPLICIT MHD CODE FOR SIMULATING LASER PLASMAS. Widner, M. M.; Wright, T. P. (Sandia Labs., Albuquerque, N. Mex.). Jan 1973. 24p. Dep. NTIS.

A two-dimensional, cylindrical MHD code, CLASP (Cylindrical Laser Plasma), was developed to study laser plasmas with self-generated magnetic fields included. Alternating Direction Implicit (ADI) difference methods are used on a regular Eulerian mesh and work well for problems whose time scale is governed by diffusion processes. In addition, flux-corrected transport algorithms provide improved accuracy for the hydrodynamics. A series of test problem and laser problem solutions is presented. The primary motivation for this development is the study of self-generated magnetic fields whose source in laser plasmas originates from a generalized Ohm's law. That is, an ambipolar electric field exists which has a nonzero curl when temperature and density gradients are not parallel. This gives rise to a time-changing magnetic field. Both magnetic field diffusion and electron thermal diffusion determine the fastest time scale for most laser plasma cases of interest and are handled well by the ADI method. (auth)

18911 NONPHYSICAL NOISES AND INSTABILITIES IN PLASMA SIMULATION DUE TO A SPATIAL GRID. Okuda, H. (Princeton Univ., NJ). J. Comput. Phys.; 10: No. 3, 475-486 (Dec 1972).

A series of plasma numerical simulation was performed in order to understand the enhancement of nonphysical noises and instabilities due to the use of a spatial grid. Several different superparticle models including the Nearest Grid Point (NGP) model, Cloud-in-Cell (CIC) or Particle-in-Cell (PIC) models, Lewis energy conserving code, and the multipole expansion code have been examined for a Maxwellian plasma and a one beam plasma using a one-dimensional, one-specie (electron) plasma. An instability was observed for all of the models when the Debye length was too small compared with the grid size. When the Debye length is comparable to the grid size, no instabilities were observed. However, the enhancement of noises at high frequencies ($\omega \gtrsim 3\omega_{pe}$) may not always be negligible even for long wavelength modes for the NGP model. For the NGP and CIC, PIC models, the experimental results are in good agreement with Langdon's theory. It is observed that the dipole expansion model, which is the first-order approximation to the multipole expansion scheme, is similar to CIC, PIC models in many respects and appears to be the same order of approximation. (auth)

18912 DESCRIPTION OF HOMOGENEOUS CLASSICAL SYSTEMS IN TERMS OF DRESSED PARTICLES. II. Application to a Debye plasma. Clavin, P.: Wallenborn, J. (Univ. Libre, Brussels). Physica; 61: No. 4, 539-565(15 Oct 1972). (In French).

An electron gas is described in the equilibrium Debye approximation in terms of dressed particles as introduced by the Brussels school. The Mandel-Turner definition of the dressing operator is used, and the validity of the so-called equilibrium condition for our model is shown. The dependence of the dressed-particle energy on velocity is shown. The correct value of all thermodynamic quantities is obtained by using only the dressed one-particle distribution function. (auth)

18913 CALCULATION OF BOUNDARY LAYERS OF COMPLETELY IONIZED TWO-TEMPERATURE PLASMA AT ASSIGNED TEMPERATURES. Korovin, V. M. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 3-10(1972). (In Russian).

The flow of plasma with different component temperatures in boundary layers was studied at the electrodes of an MHD duct. During the calculation of electron temperatures, energy equations for the electron gas were solved. The change in temperature of electrons and ions along the duct was computed, allowing for a collective transfer of energy, the work of partial pressures, Joule heating, and the energy exchange between components. The boundary layer problem and the electron flow in a flux of two-temperature, partially-ionized plasma in a simplified arrangement were examined by a technique developed by previous workers. (tr-auth)

18914 STRUCTURE OF A COLLISIONLESS BOUNDARY LAYER AND A TURBULENT RETARDATION OF IONS. Aref'ev, V. I. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 17-28(1972). (In Russian).

The flow of a low-pressure plasma in an MHD duct was unsteady in the several cases studied, the source of the instability being a current flowing transverse to the magnetic field. The investigation involved an unstable, turbulent flux of rarefied plasma in the vicinity of "magnetized electrons" and representing magnetic dipoles in the form of a plane. As the result of development of a microscopic turbulence near the electrons, a maximum current density induced in the plasma was localized, and a turbulent retardation of the advancing current occurred. The retardation energy was consumed in the turbulent heating of the plasma. The boundary layer structure was determined for a steady-state flow. The characteristic lateral dimension of the boundary layer was significantly smaller than the free path of the particles, and the boundary layer was accordingly deemed "collisionless." (tr-auth)

18915 ANOMALOUS CONDUCTIVITY OF A PLASMA IN AN EXACTLY SOLVABLE ELECTRODYNAMIC MODEL. Emets, Yu. P. (Inst. of Electrodynamics, Kiev). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 567-569(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 640-641(1972).

To analyze the effective parameters σ_{eff} and β_{eff} (conductivity and Hall) of inhomogeneous plasma systems, the following model problem is considered. Suppose a plasma is sustained between two nonconducting planes in a homogeneous magnetic field. It is assumed that the distribution of current in the plasma at right angles to the magnetic field is two dimensional. An exact solution for the current distribution for different parameters is given. The original Hilbert problem for a complex current is reduced to a Riemann boundary-value problem with discontinuous coefficients for twice-periodic functions. (MOW)

18916 CO_2-LASER-INDUCED COMPTON EFFECT IN UNDERDENSE HYDROGEN PLASMA. Offenberger, A. A.; Burnett, N. H. (Univ. of Alberta, Edmonton). Phys. Lett.; 42A: No. 7, 527-528(29 Jan 1973).

Recent experimental observation of induced scattering of CO_2 laser radiation by an underdense hydrogen plasma can be explained theoretically by nonlinear and Compton scattering from ions in the highly cooperative plasma conditions prevailing ($k\lambda_D \ll 1$). (auth)

Production

18917 (UCRL-74337) PLASMA PRODUCTION AND CONFINEMENT IN THE SUPERCONDUCTING LEVITRON. Hartman, C. W. (California Univ., Livermore. Lawrence Livermore Lab). 17 Nov 1972. 27p. (CONF-721132-1). Dep. NTIS.

From Plasma Physics Meeting of The American Physical Society; Monterey, California, United States of America (USA) (13 Nov 1972).

Experiments conducted in the Superconducting Levitron during the past year are discussed. The production and confinement of hot electron plasmas and the use of such plasmas to heat a high-density plasma by thermalization with the energetic electrons are described. The main thrust of the experiments described here is to utilize the remarkable and unique plasma confinement and stabilization properties of the vacuum fields of a single floating-ring device. In particular, interest has been directed towards developing heating techniques and studying confinement at high β. One of the most important results is that values of β of several percent (roughly 10 times that achieved in Tokamaks thus far) have been observed for what appears to be isotropic hot electron plasma, which can exhibit collective instability effects. Further, under proper conditions the confinement time of this high-β plasma is several seconds and essentially classical. (MOW)

Stability

18918 (EUR-CEA-FC-646) STABILIZATION BY SHEAR OF DRIFT INSTABILITIES. Gregoire, M.; Rolland, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nuclearies). Aug 1972. 44p. (In French). Dep. NTIS (U.S. Sales Only).

Stabilization by shear of the dissipative drift instabilities in a linear hard core configuration with a hydrogen plasma ($n = 10^{11}$ cm^{-3}, $T_{(e)} = 10$ eV, and $T_i \leq 1$ eV was studied. In the pressure range considered (10^{-3} torr to 3×10^{-3} torr), the plasma is dominated by collisions between neutral particles. A theory is developed which takes into account these types of collision and the parallel ion motion. The spatial structure of the modes and the functional dependence of the stabilization on the $B_{(z)}$, pressure, and shear parameters are systematically analyzed using correlation methods. In the presence of a shear, the waves retain their

usual drift wave structure. Their radial structure is essentially that of the lowest normal mode. The stabilizing effect of the magnetic field is quantitatively explained by the theory and demonstrates the importance of the parallel ion motion. Near to the stability, the modes present either the normal mode structure or that of convective noise. The type of mode assumed depends upon the pressure in relation to the respective stabilization law for each type of fluctuation. (France).

18919 (EUR-CEA-FC-664) THEORETICAL AND EXPERIMENTAL STUDY OF INSTABILITIES DUE TO ANISOTROPY IN A HOT ELECTRON PLASMA. Jacquinot, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Oct 1972. 207p. (In French). Dep. NTIS (U.S. Sales Only).

Thesis. Submitted to Paris Univ., France.

A theoretical and experimental study of the anisotropy-produced instabilities that can develop in a mirror-confined hot-electron plasma is presented. From the solution of the Vlasov equation in an infinite medium it is deduced that the most unstable modes are: the electromagnetic waves propagating along the field lines; the oblique electrostatic waves. In order to explain the experimental results, it was found necessary to include in the theoretical analysis the effects of the loss cone, relativistic mass variation, and cold plasma. The hot electron plasma (mean energy 15 keV) which is confined in the magnetic well of the BET experiment exhibits three confinement regimes: at low density the plasma is stable, the plasma radiation is thermal, and the confinement time is fully explained by a collision angular diffusion theory; when the density exceeds a critical value, a high-amplitude instability (frequency $\nu = 0.7\,\nu_{ce}$) develops and produces considerable diffusion into the loss cone; at intermediate densities no anomalous losses are detectable, though the plasma can amplify a convective wave injected into the plasma. The instability parameters (critical density, frequency wave length, polarization, growth rate) are in good agreement with electromagnetic theory. (France)

18920 (IPP-II-206) FORCE-FREE HELICAL EQUILIBRIA. Barberio-Corsetti, P. (Max-Planck-Institut Fuer Plasmaphysik, Garching (West Germany)). Oct 1972. 21p. Dep. NTIS (U. S. Sales Only).

The equilibrium of a helically symmetric, current-carrying low-β plasma is investigated. The solution for a force-free magnetic field $B = B^H + B^I$, generated by a current $J = V \times B^I = sB$ (s = const.) in a straight $l = 2$ stellarator vacuum field B^H, is calculated by solving the equation $V \times B = sB$ self-consistently in helical symmetry. In order to impose the appropriate boundary conditions at the limiter, a self-consistent free-boundary problem is solved. The magnetic field configuration, current distribution, magnetic surfaces, and rotational transform are calculated. (auth)

18921 INFLUENCE OF BOUNDARIES OF THE IONIZATION INSTABILITY OF A PLASMA IN A DISCHARGE OF COAXIAL GEOMETRY. Golubev, V. S.; Lebedev, F. V. (Moscow State Univ.). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 416-420 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 469-474(1972).

The influence of the boundaries of a nonequilibrium plasma on the character of the ionization instability developing in the plasma is investigated experimentally and theoretically. Estimates are presented for the influence of different dissipative processes on the dimensions of the inhomogeneities. (auth)

18922 INFLUENCE OF INELASTIC ENERGY LOSSES BY ELECTRONS ON THE DEVELOPMENT OF IONIZATION INSTABILITY IN A PLASMA. Rashkin, S. V. (Inst. of Atomic Energy, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 421-426 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 475-480(1972).

The influence of inelastic electron energy losses on the development of ionization instability in a plasma is considered. It turns out that even relatively small inelastic losses can lead to a sharp lowering of the instability limit in terms of the Hall parameter, so that the ionization instability can develop also without a magnetic field. Its manifestation in this case is more similar to that of the concentration, but the gas heating does not play a decisive role here. The vibrational specific heat of the molecules leads to a certain lowering of the increment of the ionization instability. (auth)

18923 QUASI-LINEAR THEORY OF LOW-FREQUENCY INSTABILITY OF A PLASMA LOCATED IN A WEAK SUPERHIGH-FREQUENCY ELECTRIC FIELD. Gradov, O. M.; Markeev, B. M. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 316-323 (1972). (In Russian).

Quasi-linear equations are obtained, making allowance for collisions for distribution functions of charged plasma particles located in an external homogeneous weak superhigh-frequency electric field. On the basis of these equations a system of quasi-linear equations is formulated for moments under the conditions of a near-Maxwellian particle distribution. (tr-auth)

18924 KINETIC THEORY OF THE SPATIAL INSTABILITY OF RADIALLY LIMITED PLASMA-ELECTRON STREAM SYSTEM WITH THE PRESET PLASMA RADIALLY HETEROGENEOUS CONFIGURATION. Mamedov, M. A.; Fedorchenko, A. M. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1885-1892(Nov 1972). (In Russian).

By means of computers, graphs are obtained illustrating the dependence of the increment of space instability of limited radially heterogeneous plasma electron stream system on frequency, heat velocities, and definite instability parameters. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 18617 and 18634.

18925 (CONF-721111-22) SOME FEATURES OF THE IMPACT OF A FUSION REACTOR POWER PLANT ON THE ENVIRONMENT. Draley, J. E.; Greenberg, S. (Argonne National Lab., Ill.). Nov 1972. 38p. Dep. NTIS.

From International Meeting on the Technology of Controlled Thermonuclear Fusion Experiments and the Engineering Aspects of Fusion Reactors; Austin, Texas, United States of America (USA) (20 Nov 1972).

Two specific nuclear plant locations are used in the study. One is the Bailly Nuclear station on the shore of Lake Michigan. The other site is in Oconee County in South Carolina. The reference plant is chosen to be a toroidal steady-state type operation on a D-T fuel cycle. Radioactive waste, tritium release, and various other losses are calculated. The environmental impacts from these losses are discussed. (MOW)

18926 (IPP-IV-43) APPARATUS FOR PRODUCING STICKS OF SOLID DEUTERIUM. Krause, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Aug 1972. 11p. (In German). Dep. NTIS (U.S. Sales Only).

An apparatus is described for producing sticks of solid hydrogen or deuterium in high vacuum, which are used as targets for laser-plasma experiments. The sticks are of quadratic cross section (2 mm × 2 mm) and have a length up to 15 cm. (auth)

18927 (TID-26267) ENGINEERING REVIEW OF THE PRINCETON LARGE TORUS PROJECT. Report No. 45-2-R1. (Brobeck (William M.) and Associates, Berkeley, Calif.; Princeton Univ., N. J. Plasma Physics Lab.). Jan 1973. Contract AT(04-3)-919. 31p. Dep. NTIS.

The design of the large torus (PLT) was reviewed insofar as practicable from available drawings and reference material. An independent cost estimate was prepared. The project organization is also reviewed. (MOW)

18928 PLASMA PHYSICS INDEX. Volume 7, No. 11, 1972. Bibliography, Author index, Subject index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 193p.

This listing contains 514 references on various aspects of plasma physics. (MOW)

18929 LASERS AND THE REACTOR IGNITION PROBLEM. Spalding, I. J. (Culham Lab., Abingdon, Eng.). Kvantovaya Elektron. (Moscow); No. 4, 40-47(1972). (In Russian).

Recent works devoted to laser application for ignition of thermonuclear fusion in a plasma reactor are reviewed. The laser heating of the plasma is considered for inertial and magnetic confinement under the usage of plasma reflectors and preliminary plasma compression. Anomalous laser-radiation absorption at various plasma instabilities is investigated. Heating of a toroidal reactor by powerful CO_2 lasers is considered in detail. The estimates of power, volume, efficiency, and the capital cost of the laser devices for heating of various reactors are presented. (auth)

18930 α-PARTICLE EMISSION FROM THE REGION OF THERMONUCLEAR REACTION INITIATED BY A LASER PULSE. Krokhin, O. N.; Rozanov, V. B. Kvantovaya Elektron. (Moscow); No. 4, 118-120(1972). (In Russian).

Alpha particle emission from laser-produced spherical plasma is studied; particles appear from the reaction of D-T. In the considered conditions, an α particle loses energy, mainly, on the plasma electrons. For this case, formulas are obtained that define a portion of energy carried away by α particles beyond the region of reaction. This portion depends on size, temperature, and density of the plasma. (auth)

18931 STUDY OF THE MAGNETIC FIELD OF A LINEAR OCTUPOLE WITH NEARLY CLOSED ENDS. Melendez Lugo, L.

Mexico City; Instituto Politechnico Nacional (1972). 148p. (In Spanish).

Thesis.

Some general characteristics of plasma and problems related to application are first discussed. A description of the linear octupole is then presented, followed by discussions of the computer programs used in studying the magnetic field. Following then are results obtained with the above programs such as maps of magnetic field lines, regions and contours of the stueady magnetic field, and positions of the zeros of the field. A series of conclusions are presented after comparison of this machine with existing machines, assuming low asymmetry in the linear octupole. In an appendix, the following are treated theoretically: invariance of the magnetic moment, μ; the magnetic pressure; criteria for establishment of interchange (fluting); and Bohm diffusion. (LMT)

Wave Phenomena

18932 (AEC-tr-7352) ANOMALOUS ABSORPTION OF ELECTROMAGNETIC WAVES IN MAGNETIZED PLASMA. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). Translation of report NP-19061. 1971. 6p. Dep. NTIS.

Absorption of electromagnetic waves (shf range) in a magnetized collisionless plasma was studied experimentally for $\omega_{eH}/\omega_0 \geq 0$ and $\omega_{Le}/\omega_0 < 1$. The dependence of the coefficients of wave transmission and absorption on the power of the incident wave was obtained. It was found that, at a certain power value, there was a maximum in the wave absorption. The experimental results are compared with theoretical results. The dependence of the effective collision frequency on the wave power is given. It is assumed that the observed phenomenon of anomalous absorption is associated with the development of a parametric instability in the plasma. (auth)

18933 (AEC-tr-7353) NONLINEAR EFFECT IN MICROWAVE ABSORPTION BY PLASMA. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). Translation of report NP-19072. 1971. 5p. Dep. NTIS.

Some data are reported on the absorption of superhigh-frequency waves by plasma which indicate the presence of nonlinear effects at a sufficiently high power. Experimental conditions were: the discharge tube placed in a uniform longitudinal magnetic field was 70 cm long and 2.5 cm in diameter; the operating gas was argon at a pressure of about 10^{-2} mm Hg; the concentration of charged particles was 10^{11} to 10^{12} cm^{-3}, and the electron temperature was 3 to 10 eV. The plasma was maintained under the effect of shf oscillations of a 10-cm range and a power of up to 150 W at magnetic fields higher than the electron cyclotron field: $H > H_c = mc\omega/e$; $\omega < \omega_{He} = eH/mc$. It was established that, at a power level exceeding a certain critical value, the power absorption occurred also outside the linear transformation region. As the power increased, the gap between the middle- and the high-frequency transformation regions decreased, and at a certain power value the absorption regions merged. The possibility of a decay instability as a mechanism of the above phenomenon is discussed. (auth)

18934 INTERACTION OF CENTIMETER ELECTROMAGNETIC WAVES WITH PLASMA. Marinescu, N. An. Univ. Bucuresti, Fiz.; 18: 135-151(1969). (In Rumanian).

The propagation characteristics of electromagnetic waves in the presence of an ionized medium with and without a magnetic field are discussed. The importance of plasma resonance and its relation to electromagnetic wave propagation are shown. In the presence of a steady magnetic field, the electromagnetic properties of plasma are drastically modified. In this case, the plasma behaves as a doubly refracting medium and exhibits a stop and pass band. This result has obvious implications, both from the communications and device viewpoints. The theory illustrates the importance of microwave techniques for the study of plasmas. (auth)

18935 EXCITATION OF LONG-WAVE OSCILLATIONS BY THE SECONDARY ELECTRON STREAM IN PLASMA FORMED BY ION BEAM. Protsenko, I. M.; Poritskii, V. Ya. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1847-1852(Nov 1972). (In Russian).

Results are presented of an experimental study of long-wave oscillation excitation within a plasma–ion beam system in a longitudinal magnetic field. The excited oscillation frequency (2 to 40 MHz) is determined by the secondary electron velocity and system length. The oscillations have a rotational symmetry and form standing waves along the system. The system longitudinal boundedness being taken into account, properties of these oscillations are well described by a disperse equation for electron oscillations excited by a weak beam in plasma placed in a magnetic field. (auth)

18936 THEORY OF FLUCTUATIONS IN SEMIBOUNDED PLASMA. Nguyen Van Trong (Inst. of Physics, Hanoi, Viet Nam). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1902-1909(Nov 1972). (In Russian).

Fluctuations are considered in a semibounded plasma (both isothermal and non-isothermal) without taking into account collisions. On the basis of a kinetic equation for electrons and ions, expressions are obtained for correlation functions of various physical values by the method of "random forces." It is shown that in highly nonisothermal plasma, besides high-frequency surface oscillations, there exist low-frequency ones. The dispersion law and damping coefficient of these oscillations are found. The surface oscillations are shown to be essential near the plasma boundary only. Asymptotics for the correlation functions are found when moving inside the plasma. Sharp maxima are observed in the fluctuation spectrum near the natural frequency of the surface oscillations. (auth)

18937 VYNUZHDENNOE KOMBINATSIONNOE RASSEYANIE SVCH VOLN V SLOE BESSTOLKNOVITEL'NOI PLAZMY. (Forced combination scattering of superhigh-frequency waves in a layer of collisionless plasma). Silin, V. A. Moscow; Lebedev Institute of Physics (1972). 9p.

The spectrum of shf radiation which passed through a layer of dense collision-free plasma was studied. At sufficiently large power levels of the incident wave, there appeared in the spectrum supplementary lines which had shifted from the fundamental frequency by 10 to 12 MHz toward the smaller frequencies. The dependence of the intensity of radiation in the combined frequencies on the power level of the incident wave was found, and was characterized by the threshold of detection, at which $v_E/v_{Te} = 0.2$. The experimental data obtained were compared with the theory of parametric resonance in a homogeneous plasma and with the theory of plasma instability in relation to the buildup of nonpotential and sound disturbances. (tr-auth)

18938 COLLISIONAL EFFECT ON THE SATURATION AMPLITUDE OF NONLINEARLY EXCITED PLASMA WAVES. Chang, C. T.; Chuu, D. S.; Lee, P. S.; Lee, Y. C. (State Univ. of New York, Buffalo). Phys. Lett.; 42A: No. 7, 479-480(29 Jan 1973).

The collisional effect is found to be more important than the relativistic effect in controlling the saturation amplitude of plasma waves nonlinearly excited by two laser beams under existing experiment conditions. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 17201, 17388, 17611, 17612, 18757, 18791, and 18998.

18939 (AD-747077) CALCULATION OF ELECTRON ENERGY LOSSES IN VARIOUS METALS. Midgett, J. C. (Naval Postgraduate School, Monterey, Calif.). Jun 1972. 54p. NTIS. Thesis.

A reformulation of the Blunck and Westphal theory of electron energy loss in metals was performed for the metals beryllium, aluminum, copper, tin, gadolinium, and lead. Comparison with previous theoretical calculations shows good agreement for the most probable energy loss and for the full widths at half maximum of the electron energy loss distributions. The computer program designed for these calculations is given. It is an improvement over previous programs in both computation time and simplicity. A semi-empirical formula for the most probable energy loss was calculated. This formula agrees, within a few percent, with the most probable energy loss calculated according to the Blunck and Westphal theory except in the case of thick (>3 gm/sq cm) absorbers of heavy elements. The full width at half maximum for the energy loss distribution is presented in graphical form as functions of target thickness and atomic number. (auth) (GRA)

18940 (COO-1671-44) THEORY OF RBE. Technical Progress Report. (Nebraska Univ., Lincoln). 1 Oct 1972. Contract AT(11-1)-1671. 8p. Dep. NTIS.

The theory of RBE has been applied to calculate the effect of a mixed radiation environment on detectors, dosimeters, and cells. This has made it possible to calculate the response of biological cells, for example, to beams of heavy ions, neutrons, and stopped pions. The theory provides the functional form of the response of these detectors to a radiation field once the field is specified and a compact set of radiation parameters, different for different detectors, has been determined from experiment. Using knowledge of the secondary particle spectrum in tissue and cellular parameters determined from earlier work, the calculation of the survival of kidney, HeLa, and leukemia cells after irradiation with 14 MeV neutrons is in good agreement with experiment. At the Princeton Particle Accelerator, an experiment on the survival of mammalian cells was found to be in excellent agreement with predictions of the theory, in the Bragg peak of a 4-MeV nitrogen beam. These results imply that the theory of RBE is essentially correct in principle. (auth)

18941 (COO-1671-45) THEORY OF RBE. Second Triennial Report, 1 January 1967-31 December 1972. Katz, Robert (Nebraska Univ., Lincoln. Dept. of Physics). [nd]. Contract AT(11-1)-1671. 18p. Dep. NTIS.

The theory of RBE, developed in the present research, describes the functional form of the response of many detectors, dosimeters, and biological cells with changes in radiation quality. It is based on calculations yielding the spatial distribution of energy deposited by delta rays about the path of an energetic ion, developed from studies of particle tracks in emulsion. For each detector a set of radiation properties must be determined experimentally. The theory then predicts the response of the detector to any specified radiation environment. It has been tested by the prediction of the response of mammalian cells to 14 MeV neutrons, and to the radiation field in the Bragg peak of 4 GeV nitrogen ions, with good results. Among the detectors that appear to be represented by this single, unified theory are nuclear emulsion, thermoluminescent dosimeters, scintillation counters, the Fricke dosimeter, radical production in and inactivation of enzymes and viruses, and the inactivation of a variety of biological cells (spores, bacteria, yeast, HeLa, kidney, hamster, leukemia), in culture. (auth)

18942 (EIR-222) ANALYTICAL SOLUTIONS OF THE SYSTEM OF DIFFERENTIAL EQUATIONS FROM THE S4 METHOD IN PLANE GEOMETRY AND ONE ENERGY GROUP. Gandillon, J. P.; Auerbach, T.; Haelg, W.; Mennig, J. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Aug 1972. 83p. (In French). Dep. NTIS (U. S. Sales Only).

The SN-V1 differential equation system, particularized by a linear combination of differential equations of the system defined by the Carlson method (SN method) applied to the one-dimensional transport equation, is solved in two different manners. In the first the method of solution is analytical: the solution is a linear combination of exponential functions. In the second the system is solved with the aid of the Lie series, of which only the "n" first terms are taken: the method is thus quasi-analytical. The calculation times of the two methods are compared with other methods such as the Runge-Kutta, Hemming's predictor-corrector, and the DTF-IV code of Los Alamos. (5 figures, 1 table) (tr-auth)

18943 (LA-5038) NONLINEAR RADIATION TRANSPORT SIMULATION WITH AN IMPLICIT MONTE CARLO METHOD. Carter, L. L.; Forest, C. A. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 25p. Dep. NTIS.

A method is developed to solve the radiative transport equation with Monte Carlo. The photon source aT^4 is expressed as the sum of an extraneous source term plus a pseudoscattering term by utilizing the radiative energy balance equation. This resulting photon source is sampled directly in the Monte Carlo calculation with an extrapolation of cross sections and equation-of-state data from the previous time step. (auth)

18944 (SCL-RR-720086) HANDBOOK OF PHOTO-COMPTON CURRENT DATA. Dellin, T. A. (Sandia Labs., Livermore, Calif.); MacCallum, C. J. (Sandia Labs., Albuquerque, N. Mex.). Dec 1972. Contract AT(29-1)-789. 80p. Dep. NTIS.

In a photon-irradiated medium, electron currents are created by photoelectric, Compton, and other processes. This handbook presents accurate theoretical predictions for the amplitude of these currents in 24 elements and 13 compounds for photon energies from 10 keV to 20 MeV. While these predictions are strictly valid only under photon/electron equilibrium conditions, a simple model employing the forward- and backward-directed current components is introduced to approximate the spatial dependence of nonlocal energy and charge deposition at interfaces. (auth)

18945 NEUTRON DOSIMETRY IN HUMANS. Bewley, D. K. (Hammersmith Hospital, London). Phys. Med. Biol.; 17: No. 2, 302(Mar 1972).

The neutron dose to bone from 14 MeV neutrons is discussed in outline in relation to 2 previous contradictory papers (Phys. Med. Biol., v.16, 439, 1971; Phys. Med. Biol., v.16, 461, 1971). It is concluded that the dose to bone is ~half that to contiguous soft tissues. (UK)

18946 NEUTRON DOSIMETRY IN HUMANS. Budinger, T. F. (Univ. of California, Berkeley). Phys. Med. Biol.; 17: No. 2, 303-4(Mar 1972).

Reply is made to a criticism of results in a previous paper (Phys. Med. Biol., vol. 16, 439, 1971). Absorbed doses from neutron exposure of a simulated arm, derived from Monte Carlo calculations, showed bone doses much higher than expected, particularly for 14 MeV neutrons, due to an error in the final calculations. Corrected dose distribution throughout the arm is presented in tabular form. (UK)

18947 ALGORITHM FOR LET-ANALYSIS. Kellerer, A. M. (Columbia Univ., New York). Phys. Med. Biol.; 17 No. 2, 232-40(Mar 1972).

An algorithm for the derivation of LET distributions from pulse-height spectra obtained with proportional counters is described. The method is based on Fourier transformation: it is applicable to spherical as well as nonspherical proportional counters. The relation between the energy mean L_D, of LET and the energy mean y_D, of the lineal energy density is given. (auth)

18948 X-RADIATION SPECTRA. Rechtlen, J. J.; Lautenschlager, E. P.; Norling, B. K. (Argonne National Lab., Ill.). J. Dent. Res.; 51: No. 5, 1369-74(1972).

A computer program was developed whereby input of kilovoltage, current voltage wave form, and types and thicknesses of filters results in output that predicts the x-radiation spectra encountered in dental practice. The computed results agree with measured spectra. (auth)

18949 FORMIROVANIE DOZNYKH POLEI PRI DISTANTSIONNOI GAMMA-TERAPII. (Formation of Dose Fields During Remote Gamma-Therapy). Ratner, T. G.; Bibergal, A. V. Moscow; Izdatel'stvo Nauka (1972). 176p.

Techniques for forming dose fields with a variety of stationary and mobile radiation sources, and the effects of changing the parameters of the radiation are considered. Gamma therapy equipment in use in the USSR, their operation, and methods of testing the units, are discussed. The determination or the calculation of the dose received by an irradiated organism is explained, making allowance for the nonhomogeneity of the body. The advantages and disadvantages of the various radiation patterns are analyzed: static multipole, sector, covergent, eccentric rotational radiation, and

radiation with wedge-shaped filters or without a lattice. Choice of the method must be based on the condition of the patient, the size of the part of the patient's body to be treated, and other clinical factors. Several useful ^{60}Co dose tables are presented. 318 references. (KSW)

18950 SINGLE SCATTERING APPROXIMATION IN CALCULATING DOSE RATES RESULTING FROM BACKSCATTERED γ RAYS. Bottino, A.; Zampini, F. (CNEN, Rome). Minerva Fisiconucl.; 15: No. 1, 1-14(1971). (In Italian). (RT/PROT(72) 14).

Problems involving backscattering of γ rays in determining dose rates are often met in the practice of health physics. A method has been developed for dealing with such problems in the form of a single scattering formula. Results of calculation with this formula are compared with values based on statistical methods (Monte Carlo). Various materials and variable widths are considered. It is shown that results are fairly good especially for thin sheets and heavy materials. (auth)

18951 BUILDUP FACTORS FOR γ-RADIATION SCATTERING FROM A POINT SOURCE IN AN INFINITE AIR MEDIUM. Vrubel, M. N.; Sidvena, S. N.; Strelkov, A. S. At. Energ. (USSR); 34: No. 1, 47-49(Jan 1973). (In Russian).

The non-steady state problem of the dispersal of γ-radiation from a transient point isotropic monoenergetic source in a homogeneous air medium was investigated. The values of buildup factors of an energy flux and of the absorbed energy of scattered γ-radiation were tabulated for E_0, the quantum energy, from 20 to 6,000 keV. The energy buildup factors had a maximum at 150 keV for the energy of the initial radiation. Values of the parameters found in the Berger formula were also computed. (KSW)

18952 MULTIPLE SCATTERING AT SMALL ANGLES IN THE EIKONAL APPROXIMATION. Dellagi, Mohamed. Compt. Rend., Ser. B; 275: No. 5, 215-18(31 Jul 1972). (In French).

An optical model is used to calculate the probability of a particle normally incident on a slice of material being deviated through a given angle. The normalized autocorrelation function intervenes in the calculation. (France)

18953 INTERPRETATION OF THE ENERGY-LOSS PEAKS IN THE RANGE 30 TO 70 eV IN THE SPECTRA OF ELECTRONS REFLECTED FROM TRANSITION METALS. Zashkvara, V. V.; Korsunskii, M. I.; Red'kin, V. S.; Chokin, K. Sh. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 7, 1891-1892(Jan 1973).

Translated from Fiz. Tverd. Tela; 14: No. 7, 2182-2184(Jul 1972).

For the transition metals, only the initial regions of the characteristic energy-loss spectra, up to 25 to 30 eV, can be attributed to plasma losses. The peaks at 30 to 70 eV correspond with the ultrasoft x-ray absorption spectra for metals in the periods 4 (Ti–Ni) and 6 (Hf–Pt). For metals in the fifth period (Y–Pd), whose ultrasoft x-ray absorption is not known, the peaks which cannot be classified solely as plasma or ionization peaks, are identified as being a result of ionization–plasma processes (ionization of 4p state to 4d state, accompanied by plasmon excitation). This ionization–plasma process is extended to 6th period metals (Ta, W, Re). (DLC)

18954 RADIATION DOSE-RATE. A FACTOR OF IMPORTANCE IN RADIOBIOLOGY AND RADIOTHERAPY. Hall, E. J. (Columbia Univ., New York). Brit. J. Radiol.; 45: No. 530, 81-97(Feb 1972).

The range of dose-rates employed in radiotherapy is discussed, and the literature reviewed from 1959 to 1971. At ultrahigh dose-rates (pulses of micro or nanoseconds) a clear dose-rate effect has been demonstrated for bacteria, but is less certain for mammalian cells; these dose-rates have no certain application in radiotherapy at the present time. The principle dose-rate effect is observed between 100 rads/min and 10 rads/hr; the cell-killing effect of x or γ rays decreases continuously as the dose-rate decreases throughout this range, and may be explained readily in terms of the repair of sub-lethal damage taking place during the irradiation. At lower dose-rates cell proliferation continues during the irradiation, and the ultimate outcome is a complex function of cellular radiosensitivity, dose/cell cycle and tissue adaptability. In clinical radiotherapy, the traditional pattern of high dose-rate for external beam therapy and low-dose-rate for intracavitary and interstitial therapy has been challenged in recent years. The Cathetron has made possible the use of a high dose-rate fractionated regime for intracavitary treatment of carcinoma of the cervix and for surface mould applications. Conversely, beam therapy at low dose-rate (100 rads/hr) has been proposed and introduced recently, in an attempt to combine the, allegedly, superior results of radium with the safety and convenience of a beam therapy set-up. (auth)

18955 DIGEST OF THE THIRD INTERNATIONAL CONFERENCE ON MEDICAL PHYSICS INCLUDING MEDICAL ENGINEERING. Phys. Med. Biol.: 17: No. 5, 669-743(Sep 1972).

Abstracts are presented of 300 papers read at a 5 day conference on the following subjects: (1) Radiation dosimetry, including beam dose distribution; the clinical use of computers; patient planning procedures and dose measurements; neutron dosimetry and radiation protection. (2) Radiation biology. (3) Radiotherapy, including papers on equipment, electron beam therapy; negative pion therapy; heavy ion beams; radiation sources for brachytherapy. (4) Nuclear medicine, including neutron activation analysis; studies using ^{32}P, ^{133}Xe, ^{77}Br, ^{131}I, ^{203}Pb, ^{52}Fe, ^{127}Cs, ^{129}Cs, ^{11}C, ^{15}O, ^{13}N; scanners and γ cameras; whole-body counting; diagnostic radiology. (5) Hospital instrumentation, electrophysiology and biomechanics. (UK)

18956 PROCEEDINGS OF THE AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE ANNUAL MEETING. Phys. Med. Biol.; 17: No. 6, 866-83(Nov 1972).

Abstracts are presented of papers read at a 4 day meeting. They are grouped under the following headings: (1) Physics of nuclear medicine, including the use of chelated metal ions in brain and renal scanning, tomographic techniques, reduction of scattered radiation, measurement of resolving time in scintillation cameras, production of medically useful amounts of ^{52}Fe, ^{127}Cs, and ^{129}Cs and collimator design, (2) instrumentation, with particular reference to photon beam calibration of ^{60}Co γ ray instrument calibration, intercomparisons of dosemeters, and calibration of electron beams, (3) Radiation safety in dentistry and medical radiography, (4) Diagnostic computer applications, and neutron therapy. (UK)

18957 NUMERICAL CALCULATION OF DOSE DISTRIBUTION AROUND A SYRINGE CONTAINING RADIONUCLIDES. Nishizawa, Kunihide; Maekoshi, Hisashi; Koga, Sukehiko; Sakuma, Sadayuki (Nagoya Univ., Japan). Radioisotopes (Tokyo); 21: No. 10, 603-6(Oct 1972). (In Japanese).

The dose distribution around a syringe containing radionuclides (^{59}Fe, ^{99m}Tc, ^{131}I, ^{198}Au, and ^{205}Hg) as a volume source was calculated numerically in order to obtain theoretical support for estimating the absorbed dose and planning to reduce absorbed dose from those results. Although the absorbed dose from a low specific activity source was smaller than that from a high specific activity source in the vicinity of syringe, the dose distribution at a distance did not depend on specific activity but was constant except in the axial direction of syringe. That calculated results agreed with experimental results means that either the calculating method was adequate or experimental results were theoretically supported. From these results the absorbed dose at any point can be presumed and one can frame a plan to reduce absorbed dose. (auth)

18958 ENERGY REMOVED BY DELTA RAYS FROM FINITE VOLUMES IN PASSAGE OF CHARGED PARTICLES. Laulainen, N.; Bichsel, H. (Univ. of Washington, Seattle). Nucl. Instrum. Methods; 104: No. 3, 531-9(1972).

In the passage of a charged particle through matter, the energy lost by the particle, in general, will not be the same as the energy retained by the material. Calculations of the differences caused by escaping electrons (delta rays) are presented for two experimental situations, but the methods used can be generally applied; e.g., 50-MeV protons in a carbon foil 1 mg/cm^2 thick would lose 11 keV; 10% of this energy loss would escape from the foil in the form of kinetic energy of delta rays. An escaping delta ray would appear only for about 1 in 25 protons. In a rough approximation, for protons in light elements, on the average, an energy amounting to 50 eV per MeV of initial proton energy is removed by delta rays. (auth)

18959 ION IMPLANTATION AND CHANNELLING. Davies, J. A. (Chalk River Nuclear Lab., Ont.). pp 457-563 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

The first two parts of this paper consider the question, "How deep does an ion penetrate into a solid?"; they are restricted to the low-velocity region. The first, Heavy-ion Ranges in Solids, begins by discussing the experimental situation; the anodizing-stripping method is examined, and range measurements made in this way are discussed. Experimental data in polycrystalline and amorphous targets are compared with theoretical predictions. Stopping-power (dE/dx) studies are considered briefly. The second part, Ranges in Single Crystals, begins with a historical introduction; there follow discussions of experimental techniques, qualitative features of channeled range distributions, factors affecting range profiles (temperature, bombardment dose, and misalignment and surface disorder), quantitative features of channeled range distributions, and Z_1 oscillations for channeled ions. The next two parts continue to examine channeling, but in the high-

velocity region; the channeling effects are compared with the predicted behavior from Lindhard's theoretical description. Part three discusses channeling behavior of low-Z ions (protons, helium, etc.) at MeV energies. After a brief introduction, the theoretical framework and experimental technique are discussed. General features of axial (and planar) channeling experiments are considered, and various close-encounter processes are compared. Treatments of "blocking" experiments, positron channeling, comparison with theory at zero depth, and depth dependence of χ_1 and χ_{min} conclude this part. The remainder of the paper is devoted to applications. Part four, Applications of Channeling to Solid-state Science, begins with a short stage-setting introduction; the channeling-effect technique of atom location and foreign-atom detection are briefly discussed. Applications in ion-implanted silicon are taken up, especially the Yb in silicon case. Lattice disorder and surface contamination are treated, as well as foreign-atom location on the surface and surface structure of clean crystals. Part five encompasses problems of ion implantation. After a brief discussion of general features, advantages of implantation, penetration depth, radiation damage, foreign-atom location, and the electrical behavior of implanted dopants are presented. The last part deals with nuclear and crystallographic applications of channeling. After a brief introduction to this part, crystal-alignment techniques are described. Nuclear-lifetime studies, fission lifetimes, lifetimes of the (p,p') reaction, Doppler-shift lifetime studies, and polarized deuteron beams are discussed. (93 figures, 6 tables, 112 references) (RWR)

18960 ELECTRON ENERGY LOSS SPECTROSCOPY ON AMORPHOUS AND POLYCRYSTALLINE SELENIUM AND TELLURIUM AND DETERMINATION OF OPTICAL CONSTANTS. Didden, N. (Univ., Hamburg). Z. Phys.; 257: No. 4, 310-319 (1972). (In German).

The energy-loss functions Im $-(1/\epsilon)$ of amorphous and polycrystalline selenium and tellurium were determined from energy-loss spectra of 60-keV electrons in the energy range up to 30 eV. The optical constants ϵ_1 and ϵ_2 were calculated from the energy-loss function by Kramers–Kronig analysis. The energy difference in the position of the volume plasma loss of amorphous and polycrystalline foils is compared with the calculated change in free electron plasma energy resulting from density change. Characteristic structure dependence of the optical constants was found to be similar for selenium and tellurium. It is discussed in terms of the results of band structure calculations. (5 figures, 1 table) (auth)

18961 FLOW OF ELECTRON KINETIC ENERGY THROUGH AN INTERFACE. Charlton, D. E. (Sir George Williams Univ., Montreal). Phys. Med. Biol.; 18: No. 1, 71-77(Jan 1973).

Using the methods developed for "interface" or "transition-zone" dosimetry, expressions have been evaluated that give the fraction of energy escaping from small volumes containing uniform distributions of monoenergetic electron sources. Expressions are given for planar, cylindrical and spherical geometries. As an illustration of the method of calculation the energy absorbed in tissue-equivalent spheres uniformly loaded with ^{3}H, ^{125}I, ^{14}C and ^{35}S is presented. (auth)

18962 DEPTH DOSE DETERMINATIONS. 2. A Monte Carlo Program and a Standard Man Phantom for Neutron and Gamma Computations. Frigerio, N. A., Coley, R. F.; Branson, M. H. (Argonne National Lab., IL). Phys. Med. Biol.; 18: No. 1, 53-63(Jan 1973).

A complete analog Monte Carlo program is described for the detailed computation of neutron–photon interactions with matter to at least 15 MeV with versions for the CDC 3600 and IBM 360/75 systems. Forty-five regions, of any composition chosen from fifteen elements, may be specified, of any size, interrelation and shape expressible as algebraic functions. Similarly, a variety of sources may be included. The program utilizes available data for the calculations, and with storage and output facilities gives neutron, photon and LET spectra as well as n/γ dose spectra for each region, and doses deposited in 19 360n and 19 360γ histograms. Two geometric descriptions of Standard Man are proposed, closely matching ICRP specifications. One is an eleven region phantom which is homogeneous in composition excepting the lung regions and the second a heterogeneous phantom of 29 regions. The fraction of γ-ray energy absorbed by, and the fraction of first collisions within these phantoms were obtained as a function of point source location along the phantom midline at γ-ray source energies of 0.34, 2.75 and 8.00 MeV. The results obtained differ markedly, in many regions, from those previously obtained with the simple, symmetric, homogeneous solids used as human phantoms. (auth)

18963 EFFECT OF MULTIPLE SCATTERING ON THE COMPTON PROFILE OF Be. Phillips, W. C.; Chin, A. K. (Brandeis Univ., Waltham, MA). Phil. Mag.; 27: No. 1, 87-93(Jan 1973).

Multiple Compton scattering in Be superimposed on the single Compton scattering curve a broad curve which effectively reduced the normalized experimental profile at low momenta. (UK)

Radiation Protection Standards

Refer also to abstracts 17240, 19339, and 19340.

18964 COMECON WORK IN THE FIELD OF IONIZING RADIATIONS. Yudin, M. F.; Karavaev, F. M.; Ostromukhova, G. P. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 6, 837-42(Jun 1972).

Translated from Izmer. Tekh.; 15: No. 6, 15-18(Jun 1972).

A program of work on comparing standards of units of exposed dosage of photon radiation, and of the activity of nuclides, and on developing regulatory documents governing the reproduction of units in the field of ionizing radiations, and the transmission of dimensions of units to standard-specimen and working measuring equipment which has been in progress in COMECON member-nations for the purpose of expediting unity and correctness in measurements in the field of ionizing radiations is described. (auth)

18965 CERTAIN ASPECTS OF THE CHECKING OF STANDARD ALPHA AND BETA SOURCES. Alekseev, V. Ya.; Kochin, A. E. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 6, 914-18 (Jun 1972).

Translated from Izmer. Tekh.; 15: No. 6, 60-3(Jun 1972).

Some of the problems associated with relative measurements are considered, namely: the effect of the instability of the testing installation on the results of the test; the effect of nonuniformity in the distribution of the active layer of the source; the weakening of the radiation from the sources when measuring sources with a high nuclide activity; and the effect of differences in the spectral characteristics of the radiation from the sources under comparison. (MHR)

Radiation Source Calibration and Standardization

Refer also to abstract 17687.

Shielding Calculations and Experiments

Refer also to abstracts 17226, 17925, 18495, and 18686.

18966 (EUR-4743) DEEP PENETRATION OF NEUTRONS IN HYDROGENOUS SHIELDS. Chinaglia, B.; Bosio, G. (Societa Ricerche Impianti Nucleari, Saluggia (Italy)). Oct 1972. 34p. Dep. NTIS (U. S. Sales Only). EUR B.Fr. 50.-.

The penetration of fission neutrons in hydrogenous shields was measured by means of activation detectors in well defined geometrical conditions. The experimental results refer to: a) Al-27 (n, α) reaction rate in water, measured up to 2.1 m from the Avogadro RS1 reactor core; b) several detector reaction rates covering the energy range from thermal to the Al-27 (n, α) threshold in an iron/water lamination up to 1.5 m from a disk source (EURACOS facility of CCR Euratom Ispra). The investigated thicknesses are greater than those previously reported in the literature for similar media and calculation errors which might be relevant for reactor shield design can be detected by comparison with the present experiment. The experimental results are therefore given in full detail together with the source description to permit their use for meaningful tests of shielding codes. (auth)

18967 SHIELDING EFFECTIVENESS OF RIBBED SLABS AGAINST γ RADIATION. Part II. Engineering Methods. Chilton, A. B.; Morris, E. E. (Univ. of Illinois, Urbana). Nucl. Eng. Des.; 23: No. 3, 367-375(1972).

Theoretical calculations were carried out for a wide range of cases involving γ radiation shielding by ribbed slabs. Monte Carlo methods were used for the scattered radiation and analytical and numerical techniques used for the uncollided portion. Results are expressed in terms of a ratio between the radiation level behind the ribbed slab and that behind a corresponding plane, smeared slab. Empirical formulas were established to approximate the resulting data, and the values of parameters in these formulas are

tabulated. Experimental verification and practical applications of the resulting method are discussed. (auth)

18968 SHIELDING EFFECTIVENESS OF RIBBED SLABS AGAINST γ RADIATION. Part I. Experimental and Theoretical Studies. Green, D. W.; Morris, E. E.; Preiss, K.; Chilton, A. G. (Univ. of Illinois, Urbana). Nucl. Eng. Des.; 23: No. 3, 359-366 (1972).

Theoretical and experimental studies were carried out on the shielding capabilities of "ribbed slab" configurations upon which are incident broad, parallel beams of photons similar to those emitted from a cobalt-60 source. When consideration of such non-idealized aspects as divergence of the source beam is included, the theoretical predictions and experimental measurements check very well. Certain detailed conclusions about the behavior of γ radiation which has penetrated ribbed slabs can be drawn. (auth)

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstracts 17359, 17381, and 17911.

18969 (AD–748007) TRANSIENT SURFACE DAMAGE. Final Technical Report, June 1, 1971–May 31, 1972. Simons, Mayrant (Research Triangle Inst., Durham, N. C.). Jun 1972. Contract N00014-71-C-0359. 73p. (RTI–43-U-656-FR). NTIS.

Measurements made on MOS structures during the 0.0001- to 1000-second interval following pulsed irradiation demonstrate that a rapid annealing phase is associated with the space-charge decay in SiO_2. This phenomenon is characterized in state-of-the-art thermal oxides and in oxides implanted or doped with various impurity species. A model involving thermal release of the trapped positive charge from a distribution of trapping sites in the oxide's forbidden band conveniently approximates the major features of short-term annealing. Energy density distributions for the trapped charge are developed from the annealing data and are compared for different oxides. (auth)

18970 (CONF-721010–25) CHANNELING IN CHARGED PARTICLE ANALYSIS. Mackintosh, W. D. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). 1972. 7p. Dep. NTIS (U.S. Sales Only).

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

When a matrix of interest is a single crystal, the channeling phenomenon can be exploited to increase the scope of charged-particle analyses. One application provides increased sensitivity and precision in the analysis of surface films; another, a means of locating foreign atoms within the crystal lattice. (auth)

18971 (COO–3456-1) FINAL TECHNICAL REPORT. Brown, E. (Rensselaer Polytechnic Inst., Troy, N. Y.). Dec 1971. Contract AT(11-1)-3456. 9p. Dep. NTIS.

Theoretical research is reported briefly on various topics relating to radiation damage in metals: statistical model, electron scattering from defects, equilibrium atomic configurations around defects in copper, valence electrons in alloys (Cu_3Au), lattice vibration mode in a simple metal (Na), effects of magnetic field on crystal symmetry, group theory, and effective Hamiltonians. (26 references) (DLC)

18972 (HEDL-SA–114) MICROSTRUCTURE OF FAST REACTOR IRRADIATED TYPE 316 STAINLESS STEEL. Brager, H. R.; Straalsund, J. L. (Hanford Engineering Development Lab., Richland, Wash.). 1971. Contract AT(45-1)-2170. 28p. (CONF-710557–1). Dep. NTIS.

From Spring Meeting of The Metallurgical Society; Atlanta, Georgia, United States of America (USA) (17 May 1971).

Solution-treated and 27% cold-worked Type 316 stainless steel samples were examined by transmission electron microscopy after irradiation to a neutron fluence of 2 to 3×10^{22} n/cm^2 (E > 0.1 MeV). Void diameter, void number density, and void volume data are summarized. Important microstructural features of 25% cold-worked and solution-treated steels are summarized as a function of irradiation temperature from 700 to 1550°F. Results indicate that the 20% cold-work level for FTR cladding is a good choice for minimizing irradiation swelling and maximizing stability. The thermal stability of the microstructure of 25% cold-worked Type 316 stainless steel was also studied. (DLC)

18973 (JUL–864-FF) MAGNETIC AFTEREFFECT IN NICKEL AFTER ELECTRON IRRADIATION AT 4.5°K. Knoell, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Jun 1972. 81p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

Nickel was irradiated with 3-MeV electrons at 4.5°K. Migration properties of the produced Frenkel defects were studied by means of magnetic-aftereffect measurements as well as by recovery measurements of the electrical resistance. The experimental results strongly favor an orientation aftereffect as opposed to a diffusion aftereffect. (HBG)

18974 (SC-RR–720813) ELECTRON-HOLE CARRIER DYNAMICS IN SINGLE CRYSTAL QUARTZ: EXPERIMENTAL RESULTS AND APPLICATION TO QUARTZ GAUGE PROBLEMS. Hughes, R. C. (Sandia Labs., Albuquerque, N. Mex.). Dec 1972. 26p. Dep. NTIS.

Charge-carrier generation by pulsed x rays and carrier transport in fields from 10^3 to 4×10^5 V/cm were investigated in single-crystal quartz. The photoconductivity is found to be practically independent of the angle of electric field to the crystal axes, and the carrier lifetime in both synthetic and natural quartz crystals is very short (less than 10 nsec). The average carrier mobility during the short lifetime is determined to be on the order of 0.1 cm^2/V sec, which is lower than predicted for electrons in quartz. It is shown how the photoconductivity can be used to predict the magnitude of the space-charge buildup in the Sandia quartz gauge subjected to intense radiation environments and that the dynamics of the intrinsic charge carriers are insufficient to explain the shock-induced conductivity observed in the Sandia quartz gauge in certain high-shock environments. (auth)

18975 APPLICATION OF THE THERMOQUENCHING METHOD TO AN INVESTIGATION OF γ-RADIATION EFFECTS ON PROPERTIES OF ALKALI SILICATE GLASSES. Belyavskaya, L. M.; Abramets, V. A. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 138–139 (1972). (In Russian).

Thermoluminescence curves of alkali silicate glasses excited by γ radiation (10^5 to 10^7 R) were determined. Glasses with 33% Li_2O yielded curves quite dissimilar from those from 33% Na_2O or from K_2O. The quantity of accumulated electrons as determined by the area under the curves and bounded by the temperature axis was different for the three glasses: $K_2O > Na_2O > Li_2O$. With Li_2O and Na_2O glasses (33% R_2O), the intensity of luminescence increased with radiation dose until some optimum value was reached, then decreased. Other compositions did not exhibit this behavior as clearly. (KSW)

18976 RADIATION RESISTANCE OF THERMOPLASTIC POLYMERIC DIELECTRICS. Chernyshov, V. A.; Kazakov, O. G. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 136-139(1972). (In Russian).

Samples of technical grade, thermoplastic polymers (polyethylene, polypropylene, polyvinyl chloride, FT-4) were exposed to 1.2-MeV electrons from an electrostatic generator (10^4 to 5×10^9 rad). The electric conductivity of the samples as a result of the irradiation increased by a factor of from 1 to 5; for polyethylene, a maximum was attained at 10^8 R, followed by a minimum at 2×10^9 R, then the conductivity continuously increased with increased dosage of radiation. This behavior is interpreted in terms of buildup of allyl radicals. (KSW)

18977 REACTOR IRRADIATION EXPERIMENTS WITH AMORPHOUS GERMANIUM. Tiainen, O. J. A. (Helsinki Univ. of Tech., Otaniemi, Finland). Rev. Roum. Phys.; 17: No. 10, 1199-1201 (1972).

Amorphous Ge was irradiated in a TRIGA Mark II reactor at 320°K and the resistivity measured before and after heat treatment and irradiation. Heat treatment at 520°K increases the resistivity, while the irradiation was found to decrease the resistivity and to increase the dielectric loss factor. (DLC)

18978 CHANNELING. Mezey, Gabor (Central Research Inst. for Physics, Budapest). Magy. Fiz. Foly.; 20: No. 4, 297-321(1972). (In Hungarian).

The concept of channeling, the anomalous transparency of crystals with respect to ions, and the related phenomenon of blocking are examined, reviewing the theoretical principles involved in the interaction of ions and crystal atoms, the role of the critical angle, dechanneling, and the slowing down of electrons. Depending on the type information desired concerning the crystal, a variety of experimental methods may be selected by determining the action range, transmission, backscattering, and secondary, (p,α), (p,γ) and shell excitation (p,x) type nuclear reactions. Heavy impurities in the crystal may be detected by means of wide-angle backscattering; impurities lighter than the matrix may be localized by means of nuclear reactions, such as ^{7}Li(p,α)^{4}He and ^{11}B(p,α)^{8}Be. Recognition of crystal defects by means of channeling is also reviewed. (Review article, 51 references). (TTT)

18979 CHANGE IN INTENSITY OF SPECTRAL LINES OF COMBINATION SCATTERING OF α-QUAFTZ DURING FAST-NEUTRON IRRADIATION. Zakharova, E. K.; Zubov, V. G.; Osipova, L. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 353-355(1972). (In Russian).

Quantitative data were obtained on changes in the intensity of lines in combination scattering spectra (CSS) of α-quartz, when induced by the irradiation of the quartz by a fast-neutron flux of (0.4 to 6) $\times 10^{19}$ neutrons/cm^2. Within limits, the intensities of the strongest lines in CSS were a linear function of the integrated neutron flux. A comparison was made of fast-neutron irradiation with heating the samples; the integral intensity of lines increased

with increased sample temperature, but fell with increased radiation dose. (KSW)

18980 CHANNELING OF FISSION FRAGMENTS IN SILICON. Demichelis, F.; Liscia, R.; Tartaglia, A. (Politecnico, Turin). Lett. Nuovo Cim.; 5: No. 14, 918-20(2 Dec 1972).

A thin enriched-uranium film was separated from an oriented (111) Si single crystal by a steel disk with conducting holes. After irradiation, γ counting for ^{140}Ba shows two components in the depth distribution curve, which correspond to the nonchanneled and channeled fractions. The critical angle φ_c is estimated to be 17 ± 2^1, which is slightly more than half of the calculated value of 29^1, and which is in agreement with low-energy ion measurements. (DLC)

18981 REACTOR IRRADIATION OF THE CHALCOPYRITE AND SPHALERITE FORMS OF $ZnSnAs_2$. Popescu, M. (Inst. of Physics, Bucharest); Tiainen, O. J. A.; Tuomi, T. O. Phys. Status Solid (a); 14: No. 2, 541-544(16 Dec 1972).

The effect of reactor irradiation at 300 to 310°K on the resistivity and electroreflectance of chalcopyrite and sphalerite forms of $ZnSnAs_2$ was studied. It is found that the resistivity of the chalcopyrite $ZnSnAs_2$ increases with increasing fast neutron fluence while that of the sphalerite $ZnSnAs_2$ is rather insensitive to irradiation. The irradiation-induced changes in the electroreflectance peaks in the region 2.0 to 2.8 eV attributed to $N_{1v}-N_{1c}$ transitions in the chalcopyrite $ZnSnAs_2$ were measured. In the sphalerite $ZnSnAs_2$ a splitting of the broad E_1 peak at 2.1 eV is observed after irradiation. (auth)

18982 OPTICAL AND ELECTRICAL CONDUCTIVITY STUDIES OF ION IMPLANTED INSULATORS. Crawford, J. R. Manhattan, KS; Kansas State Univ. (1972). 149p. University Microfilms Order No. 73-1160.

Thesis (Ph. D.).

Both implanted impurities and lattice damage were considered. Optical studies were carried out in connection with certain implanted impurities and optically active lattice defects. Electrical conductivity studies were employed to study defects which act as traps and thus affect the conduction processes. Almost all of the optical studies were done with MgO, while Al_2O_3 was used in the conductivity studies. In the optical studies, photoluminescence was employed so that intense laser sources could be utilized to stimulate the relatively few impurities or defect centers. The photoluminescence at 14400 cm^{-1} corresponding to an optically active lattice defect was observed and used to characterize the annealing behavior of the particular defect. It was found that the defect persisted after an anneal at 600°C and that the photoluminescence took on additional structure after the 600°C anneal when observed at liquid nitrogen temperature. However, after a 900°C anneal, the photoluminescence was no longer observable. This defect is thought to be the same as that which gives an absorption band at 17400 cm^{-1}. Dose dependence studies on the concentration of this defect indicate that it is probably simple in nature. Chromium substitutes for the cation in both MgO and Al_2O_3. The spectra for both systems have received considerable attention. In both materials the Cr ion emits a very intense red line (doublet in the case of Al_2O_3) and can be stimulated with He–Ne laser radiation. Because of this, it was chosen as the impurity to be used in studying the phenomena of implanting an impurity and causing it to move into a substitutional site by annealing. However, MgO was the only material of the two which could be produced without an inherent, observable Cr impurity already present. Even then the MgO had to be prepared in a special way. Thus Cr was implanted in MgO, and the laser-stimulated photoluminescence was observed and used to characterize the annealing behavior of the Cr impurity. Some agreement with the crystal recording temperature for MgO of 325°C and the movement of Cr atoms into substitutional sites was found, but not until after a 900°C anneal did the Cr photoluminescence closely resemble that of a single crystal with Cr impurity incorporated at growth. However, even after the 900°C anneal there were some small differences which possibly can be related to the continued presence of lattice damage. The conductivity studies were carried out on the surface of Al_2O_3 disks. The intrinsic surface conduction was found to be ohmic at lower bias and space charge limited at higher bias. The sample then was implanted with Cr but not annealed. The Cr interstitials and implant damage resulted in a noticeable increase in the number of traps which take part in the conduction process and yield an initial hysteresis. (Diss. Abstr. Int., B)

18983 EFFECT OF INSOLUBLE GAS MOLECULES ON NUCLEATION OF VOIDS IN MATERIALS SUPERSATURATED WITH BOTH VACANCIES AND INTERSTITIALS. Katz, J. L. (Clarkson Coll. of Tech., Potsdam, NY); Wiedersich, H. J. Nucl. Mater.; 46: No. 1, 41-45(Feb 1973).

In a previous paper (J. Chem. Phys.; 55: 1414(1971)), the theory of homogeneous nucleation was generalized to include the effect of the presence of antimatter, i.e., an antinucleating material, and applied to the problem of the nucleation of voids when both the vacancies and the interstitials are supersaturated. In this paper, this theory is further generalized to include the effects of insoluble gas molecules on the rates of nucleation. (auth)

18984 ELECTRON MICROSCOPY STUDY OF THE FORMATION OF CAVITIES IN COPPER AND COPPER ALLOYS IRRADIATED WITH FAST NEUTRONS. Labbe, M.; Poirier, J. P. (CEN de Saclay, Gif-sur-Yvette, France). J. Nucl. Mater.; 46: No. 1, 86-98(Feb 1973). (In French).

Copper samples were irradiated with fast neutrons at 220 to 550°C and at instantaneous fluxes of 2×10^{13} to 3×10^{24} n/cm^2 · sec > 0.1 MeV. The maximum swelling was observed at 0.45 T_f for an instantaneous flux of 3×10^{14} n/cm^2 · sec. A fourfold reduction of the instantaneous flux, at constant dose, displaces the maximum to lower temperatures and slightly increases its magnitude. Cold work before irradiation does not appear to have a significant effect on swelling. Alloying with solutes which lower the stacking-fault energy appears to displace the domains of swelling towards lower temperatures for a fixed instantaneous flux and towards lower flux for a fixed temperature. (auth)

18985 MECHANISM AND EFFICIENCY OF THE CATHODOLUMINESCENCE OF β-SiC CONTAINING RADIATIVE DEFECTS. Nesterov, A. A.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 5, 802-803(Nov 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 5, 929-931(May 1972).

A comparison was made between the cathodoluminescence and electroluminescence spectra of β-SiC crystals after irradiation with 3.5-MeV electrons. Results are in favor of the hypothesis that the radiative transitions in the red band do not involve free carriers but are likely to occur within the luminescence centers. The external efficiency of the cathodoluminescence was measured to be ~0.13%. The probability of radiative transitions is close to unity. (DLC)

18986 SOME FURTHER COMMENTS ON STAGE III RECOVERY IN GROUP VA BODY-CENTERED-CUBIC TRANSITION METALS. Johnson, A. A. (Washington State Univ., Pullman). Scr. Met.; 7: No. 1, 15-19(Jan 1973).

It is shown that changing the purity of Nb can change the rate-controlling deformation mechanism and thus the rate at which Stage III defects are generated. The statement of Wechsler et al. (Scr. Met., 7: 7(1973)) that vacancies should be produced on deformation in pure Nb as readily as in less pure Nb is not true. Results for irradiated doped Nb, internal friction measurements, and obedience of the Arrhenius equation by the recovery of irradiated V are discussed. It is emphasized that the author has no stake in the debate. (DLC)

18987 COMMENTS ON STAGE III ANNEALING IN GROUP VA BODY-CENTERED-CUBIC TRANSITION METALS. Wechsler, M. S.; (Ames Lab., IA); Williams, J. M.; Stanley, J. T. Scr. Met.; 7: No. 1, 7-14(Jan 1973).

The interstitial impurity mechanism suggested by Stanley (Acta Met., 20: 191(1972)) and the vacancy mechanism by Johnson (Scr. Met., 7: 1(1973)) for the stage III annealing in Nb, V, etc., are discussed. Data on deformed Nb, irradiated Nb, and irradiated V are reviewed. It is concluded that the interstitial impurity mechanism is still the more likely explanation for Stage III annealing. (20 references) (DLC)

18988 STAGE III IN GROUP VA BODY-CENTERED CUBIC TRANSITION METALS. Johnson, A. A. (Washington State Univ., Pullman). Scr. Met.; 7: No. 1, 1-5(Jan 1973).

Results of a study of stage III annealing in plastically deformed Nb are presented. The work was carried out on two types of Nb wire: one was recrystallized at 1325°C following 90% area reduction by drawing, while the other was stress-relieved at 700°C following a similar wire drawing treatment. Samples of both types of wire were deformed up to 12% in tension and then subjected to isochronal and isothermal annealing treatments. The electrical resistance was measured at 77°K after each treatment. Results show that a given tensile strain produces more stage III recovery in a stress-relieved specimen than in a recrystallized specimen. The model of Stanley (Acta Met., 20: 191(1972)) for stage III annealing is criticized. (DLC)

18989 ILLUMINATION-INDUCED ANNEALING IN ELECTRON-IRRADIATED P-TYPE SILICON. Nakashima, K. (Nagoya Inst. of Tech., Japan). Phys. Lett.; 42A: No. 7, 533-534(29 Jan 1973).

Illumination with white light during isochronal annealing in p-type Si irradiated with 2-MeV electrons at 77°K introduces stages of recovery at around 85 and 140°K. These stages recover about 90% of carriers removed by the irradiation. (auth)

18990 ELECTRON SCATTERING BY SINGLE CRYSTALS. Vorob'ev, A. A.; Bobudaev, A. Y.; Vorob'ev, S. A.; Kaplin, V. V. (Tomsk Polytechnic Inst., USSR). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 7, 1864-1865(Jan 1973).

Translated from Fiz. Tverd. Tela; 14: No. 7, 2157-2159(Jul 1972).

In an attempt to detect anomalous transmission of electrons through a single crystal, measurements were made of the intensities of collimated $^{90}Y-^{90}Sr$ electrons scattered through large angles and transmitted in the forward direction as functions of angular position of the NaCl single crystal. For the forward direction, a minimum occurs in the central part of the maximum, while for the scattering angle 142°, the minimum has a maximum in its center. Results indicate increased large-angle scattering when the ⟨100⟩ axis is aligned with the beam. (DLC)

18991 SHAPE OF THE PLANAR SHADOW FOR SCATTERING OF PARTICLES BY A THICK SINGLE CRYSTAL. Pokhil, G. P.; Tulinov, A. F. (Moscow State Univ.). Sov. Phys. Solid State (Engl. Transl.); 14: No. 7, 1669-1672(Jan 1973).

Translated from Fiz. Tverd. Tela; 14: No. 7, 1927-1932(Jul 1972).

An analytical attempt is made to trace the regularities involved in dechanneling of particles from a planar channel in a single crystal. Under certain simplifying assumptions, the shape of the back shadow is described for various positions of the scattering layer within the crystal. (auth)

18992 EFFECT OF γ IRRADIATION ON THE THERMAL EXPANSION COEFFICIENTS OF TRIGLYCINE FLUOROBERYLLATE. Varikash, V. M.; Zarembovskaya, T. A.; Lagutina, Z. P. (Minsk Radio Engineering Inst.). Sov. Phys.-Cryst. (Engl. Transl.); 17: No. 4, 768-769(1973).

Translated from Kristallografiya; 17: No. 4, 473-474(1972).

The effects of γ doses up to 500 mR on the temperature dependence of the crystal dimensions along the [001], [010], and [101] directions were studied. For the [001] and [101] directions, irradiation lowers the thermal expansion coefficient in both the ferroelectric and paraelectric phases. For [001], the coefficient was virtually zero above the Curie point, but after irradiation it became negative. For [010], the negative coefficient disappears after irradiation. The dielectric hysteresis loops also disappear on irradiation. (DLC)

18993 TRANSILLUMINATION PROTON DIFFRACTION OF SINGLE CRYSTAL FILMS. Geguzin, Ya. E.; Markus, A. M.; Gorokhov, M. V. (Kharkov State Univ.). Sov. Phys. Cryst. (Engl. Transl.); 17: No. 4, 686-690(1973).

Translated from Kristallografiya; 17: No. 4, 783-787(1972).

Certain aspects of the structural method of "transillumination" proton diffraction are discussed; for this method the effects of the integral dose and multiple scattering of protons are important. The indexing of proton-diffraction patterns obtained from a single-crystal gold film is illustrated. (auth)

18994 STUDY OF INTERATOMIC POTENTIALS BY PLANAR CHANNELING EXPERIMENTS. Robinson, M. T. (Oak Ridge National Lab., TN). pp 281-297 of Interatomic Potentials and Simulation of Lattice Defects. Gehlen, P. C. (ed.). New York; Plenum Publishing Corp. (1972).

From Conference on Interatomic Potentials and Simulation of Lattice Defects; Seattle, WA. and Harrison Hot Springs, B. C., (14 Jun 1971). See CONF-710621–.

The model described permits experimental data on the energy losses of ions transmitted through planar channels in thin monocrystalline targets to be used to study interatomic potentials in the separation region near 1 Å. The method depends upon the empirical observation that the rate of energy loss of such ions is a linear function of their transverse oscillation frequency in traversing the channel. The techniques are illustrated by application to some recent data on the channeling of several ions in gold, silver, and silicon. (12 figures, 16 references) (auth)

18995 COMPUTER SIMULATION OF THE SHORT-TERM ANNEALING OF DISPLACEMENT CASCADES. Doran, D. G. (WADCO Corp., Richland, WA); Burnett, R. A. pp 403-422 of Interatomic Potentials and Simulation of Lattice Defects. Gehlen, P. C. (ed.). New York; Plenum Publishing Corp. (1972).

From Conference on Interatomic Potentials and Simulation of Lattice Defects; Seattle, WA and Harrison Hot Springs, B. C. (14 Jun 1971). See CONF-710621–.

An important source of damage to a solid exposed to high-energy neutrons (or ions) is the displacement of atoms from normal lattice sites. In a fast reactor, energies of tens of keV may be transferred to an atom and thus initiate a displacement cascade consisting of a localized high density of interstitials and vacancies. These defects will subsequently interact with one another to form clusters and to reduce their density by mutual annihilation. This short-term annealing was simulated with a small computer using an atomic model of γ-iron based on the work of Johnson (Phys. Rev., 145: 423 and 152: 629(1966)). The input cascades are due to Beeler (Phys. Rev., 150: 470(1966)). Results were obtained with both large (104 sites) and small (32 sites) annihilation regions. The former results in about one-half the residual defects of the latter, and a smaller fraction of clustered defects. Cluster size distributions and several examples of spatial distributions are given. Randomizing the spatial distribution of defects in a typical cascade geometry is found to diminish vacancy clustering and enhance interstitial clustering. (auth)

18996 COMPUTER SIMULATION OF ATOMIC DISPLACEMENT CASCADES IN SOLIDS. Torrens, I. M. (CEN, Saclay, France); Robinson, M. T. pp 423-438 of Interatomic Potentials and Simulation of Lattice Defects. Gehlen, P. C. (ed.). New York; Plenum Publishing Corp. (1972).

From Conference on Interatomic Potentials and Simulation of Lattice Defects; Seattle, WA and Harrison Hot Springs, B. C. (14 Jun 1971). See CONF-710621–.

Atomic displacement cascades originating from primary atoms displaced with energy up to 100 keV were investigated by computer simulation. The model includes inelastic energy loss and finite temperature effects. Results obtained for crystals of copper, iron, and gold indicate that long-range channeling and focusing are rare. The numbers of vacancies created and of those remaining are both directly proportional to the primary energy corrected for inelastic loss over the energy range up to 100 keV. The number of clusters of i vacancies is in constant ratio to the number of clusters of (i – 1) vacancies, this ratio being independent of primary energy. (auth)

18997 EPR STUDIES OF NUCLEAR RADIATION INDUCED DEFECTS IN ALKALI HALIDES. Ursu, I. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17, No. 8, 955-967 (1972).

Magnetic resonance methods including different double and triple resonance methods are surveyed. Their possibilities in studying the point defects in crystalline lattices are shown. In order to exemplify these possibilities, the results obtained in the case of atomic oxygen centers in alkali halides are discussed. (auth)

18998 COLLISION THEORY OF DISPLACEMENT DAMAGE. IV. ION RANGE AND SPUTTERING. Sigmund, P. Rev. Roum. Phys.; 17, No. 8, 969-1000(1972).

This lecture deals with the dissipation of energy during slowdown of fast ions or recoil atoms, the number of atoms set in motion, and their distribution in energy and space. The approach is essentially to keep a detailed record of colliding atoms, without taking into account defect characteristics except at a rather late stage. The mathematical basis is a modification of the collision-density concept, well known from neutron-transport theory, and used in cascade theory by a number of authors. (76 references) (LMT)

18999 HYPERSONIC ATTENUATION IN MgO. Lange, J. N. (Oklahoma State Univ., Stillwater). pp 238-42 of International Conference on Phonon Scattering in Solids. /Albany, H. J. (ed.). Saclay, France; Centre d'Etudes Nucleaires de Saclay (1972).

From International conference on phonon scattering in solids; Paris, France (3 Jul 1972). See CONF-720720.

The effects of impurities and defects on ultrasonic attenuation in MgO are studied at low temperatures. The impurity and defect valence are altered by thermal cycling and γ irradiation. A relaxation process associated with Al and the OH radical impurities is observed. The introduction of color centers by γ irradiation decreases the background attenuation. (France)

19000 ACOUSTIC PARAMAGNETIC RESONANCE OF V^{4+} IONS IN Al_2O_3. Abou-Ghantous, M. (CEN, Grenoble, France); Bates, C. A. pp 266-71 of International Conference on Phonon Scattering in Solids. /Albany, H. J. (ed.). Saclay, France; Centre d'Etudes Nucleaires de Saclay (1972).

From International conference on phonon scattering in solids; Paris, France (3 Jul 1972). See CONF-720720.

In addition to the well-known a.p.r. spectra of V^{3+} ions, a new packet of eight hyperfine lines was observed at 8.975 GHz in a crystal of Al_2O_3 containing 260 ppm vanadium, after γ irradiation, which is ascribed to V^{4+} ions. The properties of these lines (angular dependance of the resonance field, variation of the intensity with temperature) are in agreement with the hypothesis of transitions inside the ground-state Kramers doublet of V^{4+} ions. The spin-Hamiltonian parameters and the spin–phonon coupling constants are given. The variation in the a.p.r. linewidth and the above parameters are explained using dynamic Jahn–Teller

effects. The Ham reduction factor is found to be approximately 0.09 and second-order effects give significant contributions. (France)

19001 ELIMINATION OF Cr^{4+} IONS AS A SOURCE OF STRONG RESONANT PHONON SCATTERING IN RUBIES. Brown, M. A. (CEN, Grenoble, France); de Goer, A. M.; Villedieu, M.; Deivismes, N. pp 272-6 of International Conference on Phonon Scattering in Solids. Albany, H. J. (ed.) Saclay, France; Centre d'Etudes Nucleaires de Saclay (1972). (In French).

From International conference on phonon scattering in solids; Paris, France (3 Jul 1972). See CONF-720720.

The thermal conductivities of an orange ruby and a series of pink rubies were measured at 1.3 to 100°K before and after having exposed the rubies to γ radiation at ~80°K. Coupled optical absorption (R lines) and ESR line intensity measurements enabled the relative variations in the concentrations of Cr^{4+} and Cr^{3+} ions to be estimated. It is concluded from these measurements that the Cr^{4+} ions are not a very efficient source of resonant phonon scattering. (France)

19002 HYPERSONIC ATTENUATION IN GAMMA-IRRADIATED QUARTZ. Nava, R.; Rodriguez, M. pp 280-8 of International Conference on Phonon Scattering in Solids. /Albany, H. J. (ed.). Saclay, France; Centre d'Etudes Nucleaires de Saclay (1972).

From International conference on phonon scattering in solids; Paris, France (3 Jul 1972). See CONF-720720.

The attenuation of ultrasonic waves in quartz crystals irradiated with gamma rays was studied. The absorption data is discussed in relation to the scattering of thermal phonons by lattice point defects and by phonon-assisted tunnelling transitions of the trapped hole at the substitutional Al impurity in smoky quartz. (France)

19003 SPECTRAL PROPERTIES OF Tb^{3+} IONS IN CRYSTALS AND GLASSES. Batsanov, S. S.; Batsanova, L. R.; Glazunov, O. O.; (and others). Zh. Prikl. Spektrosk.; 17: No. 3, 448-53(Sep 1972). (In Russian).

The spectra of photo- and x-ray-luminescence of single and polycrystals of $CaF_2:Tb^{3+}$ and boron anhydride-type glasses containing NaF and Tb were found to be similar. Gamma quanta from ^{60}Co produced coloration in CaF_2-Tb^{3+} and in glasses, with concomitant reduction in luminescence. This coloration did not affect the photoluminescence spectra. (KSW)

19004 DYNAMIC SELF-POLARIZATION OF NUCLEI IN SOLIDS. D'yakonov, M. I.; Perel, V. I. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 16: No. 10, 398-401(20 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 10, 563-566.

A system of nuclear spins, artificially maintained in a disordered spin state, and interacting with electrons is considered. It is shown that under these conditions, at sufficiently low temperature, the disordered state of the nuclear spins is unstable (even in the absence of an external magnetic field). On the other hand, the state with practically complete ionization of the nuclei turns out to be stable. In this state, the polarized nuclei produce an effective magnetic field that acts on the spins of the electrons and is due to the hyperfine interaction. The nuclear polarization itself is maintained by the Overhauser effect in this effective field. (auth)

19005 IRRADIATION CREEP DUE TO THE GROWTH OF INTERSTITIAL LOOPS. Brailsford, A. D.; Bullough, R. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag.; 27: No. 1, 49-64(Jan 1973).

A rate theory of the growth of irradiation-produced interstitial loops in uniaxially stressed materials that also contain voids, coherent and/or incoherent precipitates, and network dislocations is derived, and the resulting creep behavior is determined. Allowance is made for the preferential nucleation of loops oriented perpendicular to the stress axis and for the subsequent enhanced growth of these same loops. It is shown that the first of these mechanisms dominates and gives a creep rate that can be correlated with the volume-swelling rate. The magnitude of the effect is shown to be consistent with the limited amount of available experimental data appropriate to the void-swelling temperature regime. (UK)

19006 INFLUENCE OF DISLOCATIONS ON THE NUCLEATION OF VOIDS IN NICKEL. Harbottle, J. E. (Central Electricity Generating Board, Berkeley, Eng.). Phil. Mag.; 27: No. 1, 147-157(Jan 1973).

The influence of dislocation behavior on void formation and growth was studied in the High Voltage Electron Microscope (HVEM). Variation of the interstitial loop density was used to control the concentration of biased linear sinks available for point defects and thereby the vacancy excess required for void growth. The interstitial loops were nucleated by neutron irradiation at 50°C and a good correlation was obtained between the loop concentration and swelling by electron irradiation at 400°C. Void development was closely related to the detailed microstructural changes that occurred immediately upon electron irradiation. A minimum foil thickness was necessary for void growth in the HVEM, otherwise the surfaces dominate, and the dislocation density always remained low. Voids did not grow if the dislocation density was less than 10^9 lines/cm^2. (UK)

19007 DISLOCATION INTERACTION WITH IRRADIATION DAMAGE IN THE HIGH-VOLTAGE ELECTRON MICROSCOPE. Stobbs, W. M. (Cambridge Univ., Eng.). Phil. Mag.; 27: No. 1, 257-263(Jan 1973).

A form of the weak-beam technique is described and shown to provide useful information about the dislocation interaction with the irradiation-produced point defects in the high-voltage electron microscope. Possible mechanisms to explain the preliminary experimental observations are discussed. (UK)

Physical Properties

Refer also to abstracts 17307, 17746, 17753, 17754, 17762, 17770, 17802, 17846, 17879, and 18608.

19008 (CONF-721059–(Absts.)) SECOND AINSE NEUTRON DIFFRACTION CONFERENCE, LUCAS HEIGHTS, OCTOBER 16–17, 1972. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). 34p.

Thirty-three papers deal with neutron-diffraction studies in structure analysis of inorganic and organic compounds. Each appears in summary form only. (Australia)

19009 (COO–1198-937) PHONON SCATTERING BY CONDUCTION ELECTRONS IN CARBIDES OF TRANSITION METALS. Williams, W. S. (Illinois Univ., Urbana). 1972. 5p. (CONF-720720–1). Dep. NTIS.

From International conference on phonon scattering in solids; Paris, France (3 Jul 1972).

In summary, this work has provided: the first thermal conductivity data on single crystals of transition-metal carbides in any temperature range; the first thermal conductivity data on transition-metal carbides in any form in the liquid helium range; an explanation for the low thermal conductivity of the carbides in this temperature range in terms of phonon scattering by conduction electrons; an explanation for the low thermal conductivity of the carbides at high temperatures in terms of phonon scattering by carbon vacancies; the discovery of a "phonon switch"; a successful application of BRT theory; and the first evaluation of an energy-gap parameter for the transition-metal carbides. (auth)

19010 (JUL-872-FF) NEUTRON MEASUREMENT IN TWO SYSTEMS OF HYDROGEN BONDS. Arsic-Eskinja, M. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Jul 1972. 68p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

By means of elastic incoherent neutron scattering, the position probability of individual protons was studied in $KHCO_3$ and in KH_2PO_4. Results showed that, at room temperature, the thermal proton cloud was anisotropic in the two systems. $KHCO_3$ showed an elongation perpendicular to the direction of the hydrogen bond, while KH_2PO_4 displayed an elongation in the direction of the hydrogen bond. With decreasing temperature, the anisotropy of $KHCO_3$ underwent little change. In KH_2PO_4, however, the cloud contracted into a sphere during the approach toward the ferroelectric transformation (122°K). Below that temperature, a new elongation occurred which now was perpendicular to the direction of the hydrogen bond. The observations confirmed that, in the paraelectric phase, each proton fluctuated between two equilibrium positions. (tr-auth)

19011 (JUL-876-FF) DIFFUSION CONSTANTS AND HEAT OF TRANSPORT OF HYDROGEN AND DEUTERIUM IN NIOBIUM. Wipf, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Jul 1972. 93p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Universitaet, Munich (West Germany).

In niobium, diffusion constants and transport heat were determined for hydrogen and deuterium, respectively. Measurements were performed on the alpha phase of the systems with 0.2 at.% of H or D. Temperatures ranged from 150 to 320°K. Hydrogen diffusion showed a marked change in activation energy at 225°K, while deuterium remained constant. The ratio of the diffusion constants between hydrogen and deuterium grew from 2 (at room tem-

perature) to about 15 (at 150°K). Activation energies were independent of concentration. Transport heats for both hydrogen and deuterium were positive and amounted to about 0.12 and 0.14 eV, respectively. In contrast to the activation energy, the transport heat of hydrogen displayed no marked change at 225°K. Presently existing theoretical models failed to explain the experimental results. (HBG)

19012 (JUL-878-FF) RESISTANCE RELAXATION IN THE SYSTEM NIOBIUM-HYDROGEN. Schnabel, D. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Aug 1972. 84p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

In hydrogen-containing niobium samples, the H atoms migrate from the compressed into the dilated areas under an inhomogeneous elastic stress. This redistribution can be followed with measurements of the electric resistance. Comparison of the experimental data with the lattice-gas model yields a maximal hydrogen concentration of 81 ± 6 (at.%) and a mean interaction energy of 0.26 ± 0.02 (eV/100 at.%). The experimental interaction energies agree with the calculated elastic interaction energy. Therefore, it is concluded that the attracting interaction primarily displays an elastic character. Agreement of the experiments with the lattice-gas model supports the existence of long-range interactions. The diffusion constant depends on the concentration and shows a critical slowing down. (HBG)

19013 SURFACE IONIZATION OF RARE EARTHS ON TUNGSTEN. Floyd, R. L. Pullman, WA; Washington State Univ. (1972). 80p. University Microfilms Order No. 73-45.

Thesis (Ph.D.).

A study of the surface ionization of Gd, Tb, Dy, and Ho is described, and results are compared with the predictions of the Saha-Langmuir equation. The experimental index parameter, E, which should be equal to the difference between the first ionization potential of the element and the work function of the surface, was found to differ from the predicted value by the following amounts: Gd, 0.68 ± 0.14 eV; Tb, 0.28 ± 0.13 eV; Dy, 0.25 ± 0.12 eV; and Ho, 0.26 ± 0.13 eV. The (110) face of a tungsten single-crystal was used as the ionizing surface, and its work function was determined to be 5.46 ± 0.11 eV in an auxiliary study of the emission of tungsten ions. This work and other studies demonstrate the inadequacy of the Saha-Langmuir equation for the description of the surface ionization of complicated atoms at single-crystal tungsten surfaces and points up the need for further theoretical studies of the subject. (Diss. Abstr. Int., B)

19014 I-V CHARACTERISTICS OF PALLADIUM AND VANADIUM FILMS. Kreinina, G. S. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 6, 985-987(Jun 1972).

Translated from Radiotekh. Elektron.; 17: No. 6, 1269-1272(Jun 1972).

A changeover from monotonically increasing I-V characteristics to loop-shaped characteristics with a current maximum and a voltage maximum was obtained experimentally for vanadium and palladium films. (auth)

19015 ENTHALPY AND SPECIFIC HEAT OF TANTALUM CARBIDE IN THE RANGE 273 TO 3600°K. Sheindlin, A. E.; Belevich, I. S.; Kozhevnikov, I. G. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 581-583(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 650-652(1972).

The enthalpy and specific heat of tantalum carbide were determined in an apparatus based on the method of mixing. According to chemical analysis, the original tantalum carbide samples contained 93% Ta and 7% C_{tot}, including 0.7% C_{free}. According to the ratio of tantalum and combined carbon this material was close to stoichiometric composition, i.e., the samples contained 99.3% $TaC_{1.0}$ and 0.7% C. After a series of experiments in which the samples were heated to 3000 to 3500°K the chemical analysis of the same samples was repeated. The results of the analysis coincided with the original composition within the limits of experimental error. The experimental values of the enthalpy and specific heat of tantalum carbide of the foregoing composition are presented. (auth)

19016 MAGNETORESISTANCE AND HALL EFFECT FOR VANADIUM DIBORIDE IN A TWO-ZONE REPRESENTATION. Malinskii, B. I.; Nemchenko, V. F.; L'vov, S. N. (Kherson Pedagogical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 55-59(1972). (In Russian).

Measurements were made of the magnetoresistance and Hall coefficient of VB_2 at 77 and 300°K in magnetic fields from 5 to 25 kOe. The two-zonal model for VB_2 is compared with the corresponding data for TiB_2, TiC, and TiN. (KSW)

19017 STRUCTURE AND MAGNETIC PROPERTIES OF SAMARIUM AND Sm_2O_3. Perakis, N.; Kern, F. (Univ., Strasbourg). Compt. Rend., Ser. B; 275: No. 19, 677-680(6 Nov 1972). (In French).

Results of magnetic susceptibility measurements of samarium and the Sm_2O_3 oxide at low temperatures are presented. Their structures were also studied. (France)

19018 LOW TEMPERATURE SPECIFIC HEATS OF DYSPROSIUM DIHYDRIDE DyH_2. Bieganski, Z.; Opyrchal, J. (Inst. for Low Temperature and Structural Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 20: No. 8, 775-782(1972).

The low-temperature specific heats of dysprosium dihydride $DyH_{2.00}$ were measured at 20 to 345°K by adiabatic calorimetry. The specific heat at constant pressure C_p, the entropy S^0, enthalpy function $(H^0 - H_0^0)$ and Gibbs function $-(G^0 - H_0^0)/T$ at 298.15°K are: 8.93 cal mol^{-1} K^{-1}, 15.45 cal mol^{-1} K^{-1}, 1853 cal mol^{-1} K^{-1} and 9.23 cal mol^{-1} K^{-1}, respectively. The influence of crystal field of cubic symmetry on the splitting of the ground state $^6H_{15/2}$ of the free Dy^{3+} ion in dysprosium dihydride was analysed and the conclusion was drawn that the doublet Γ_7 is the lowest lying level supporting the anionic-like character of hydrogen in this hydride. (auth)

19019 CALCULATION OF THE MAGNETIZATION AND TOTAL ENERGY OF VANADIUM AS A FUNCTION OF LATTICE PARAMETER. Hattox, T. M. Gainesville, FL; Univ. of Florida (1972). 103p. University Microfilms Order No. 73-568.

Thesis (Ph. D.).

Self-consistent, spin-polarized APW calculations were performed within the $X\alpha$ and muffin-tin approximations to determine the energy band structure of metallic vanadium in an assumed ferromagnetic bcc structure as a function of lattice parameter. At each lattice parameter for which a self-consistent energy band calculation was performed, the $X\alpha$ total energy per unit cell, the pressure, and the magnetization were also calculated. The equilibrium lattice constant, cohesive energy, and compressibility were obtained from these results, and agree well with experiment. The calculations also correctly predict the absence of a magnetic moment for vanadium at its equilibrium lattice constant. However, a nonmagnetic-to-magnetic transition was found to occur abruptly beyond the equilibrium lattice constant (at about 1.25 a_0). It was found that, in order to obtain reliable magnetic results, interpolation of the energy bands is required in order to determine more accurate weighing factors for states near the Fermi level, and a computer program was developed for doing this. (Diss. Abstr. Int., B)

19020 CRYSTAL CHEMISTRY OF REFRACTORY CARBIDES. Bowman, A. L. (Los Alamos Scientific Lab., NM). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 364, 561-6(1972).

From 5th materials research symposium on solid state chemistry; Gaithersburg, Md. (18 Oct 1971). See SPEC.-PUBL-364; CONF-711019.

The crystal structures of most of the refractory metal carbides may be described generally on the basis of a close-packed metal sublattice, with the carbon atoms occupying all or part of the octahedral sites. Close-packed carbide structures have been observed with composition MC and packing type c, M_3C_3 and hhcc, M_3C_2 and hcc or hhc, and M_2C and h or c. All of these structures have one octahedral site per metal atom, and thus an apparent possible composition MC. This is reached however, only with the c-type packing, and it has been suggested that only one half of the sites adjacent to an h layer can be filled. This was found to be an upper limit that is not always reached. These carbide structures thus have carbon vacancy concentrations ranging from ~0 up to ~70%, with a possibility of vacancy ordering. Neutron and electron diffraction studies have shown ordering to exist in the M_2C compounds and in carbon-deficient VC. The order-disorder transformation of the carbon vacancies in Mo_2C has been studied in detail with high-temperature neutron diffraction. The kinetics data are consistent with a nucleation-growth mechanism involving nucleation on grain boundaries and linear growth across the interface. The reaction between Mo_2C and Mo_3C_2, involving the transformation of the close-packed metal lattice (h ⇌ hcc) has been studied less thoroughly, but the kinetics data also appear to be consistent with a nucleation-growth mechanism. (auth)

19021 ANOMALOUS MAGNETIC SUSCEPTIBILITY AND SUPERCONDUCTIVITY OF PLATINUM-TUNGSTEN ALLOYS. Khan, H. R.; Raub, C. J. Metall.; 26: No. 12, 1221-1223(Dec 1972). (In German).

Magnetic measurements on platinum-tungsten alloys yield an explanation for the observed anomalies in the transition temperature or the lattice constant-concentration curve, respectively. These effects are determined through the filling of the d- and s-p bands, respectively. (tr-auth)

19022 DEBYE–WALLER FACTOR AND DEBYE TEMPERATURE FOR Fe, Mo, Ta, AND W. Merisalo, M.; Paakkari, T. (Univ. of Helsinki). Mater. Res. Bull.; 8: No. 2, 195-199(Feb 1973).

The Debye–Waller parameter and the Debye temperature for iron, molybdenum, tantalum, and tungsten were calculated from general force-constant models. Comparison of the x-ray Debye temperatures with the heat-capacity Debye temperatures is made and discussed. (auth)

19023 CHANGE IN ELECTRICAL RESISTIVITY OF LEAD AFTER CREEP IN NORMAL AND SUPERCONDUCTING STATES. Gindin, I. A.; Lebedev, V. P.; Starodubov, Y. D. (Physical Technical Inst., Kharkov). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 7, 1748-1751(Jan 1973).

Translated from Fiz. Tverd. Tela; 14: No. 7, 2025-2029(Jul 1972).

The electrical resistivity ρ of polycrystalline lead (99.9994%) in the intermediate creep stage was measured in the normal state (T = 4.2°K, H = 1450 Oe) and after creep deformation in the superconducting state. It was found that during creep in the normal state, ρ varies with time in the same way as the deformation. Identical deformations in the normal and superconducting states produce different increases in the electrical resistivity, deformation in the superconducting state leading to the greater increase in ρ. The change in the value of $\alpha = (\Delta\rho/\Delta\xi)$ with the degree of deformation has been determined for the normal and superconducting states. Possible reasons for the greater increase in α in the superconducting state are analyzed, and views are expressed about the contributions of the dynamic and static factors to the softening effect observed in the metal at the superconducting transition. (auth)

19024 TEMPERATURE BROADENING AND SHIFT OF PHONONLESS LINES IN LUMINESCENCE SPECTRA OF CRYSTALS OF URANYL COMPOUNDS. Shchelokov, R. N.; Krasilov, Yu. I.; Karasev, V. E. (Inst. of General and Inorganic Chemistry, Moscow). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 7, 1885-1886(Jan 1973).

Translated from Fiz. Tverd. Tela; 14: No. 7, 2175-2177(Jul 1972).

A study was made of the electron-vibrational spectra of $K_3UO_2F_5$ and $Rb_3UO_2F_5$. At 120 to 300°K, the line contour is described well by a Lorentz curve and at 77 to 120°K by a convolution of Gauss and Lorentz curves. The broadening of the lines is described well in the weak-coupling approximation of the theory ($\theta = 300 \pm 30$°K), but the temperature shift of the lines has a power-law dependence $\Delta\Omega(T) = \beta T^n$ ($n = 4.0 \pm 0.1$). Results indicate that the line broadening is mainly due to low-frequency deformational and vibrational oscillations. (DLC)

19025 EXPERIMENTAL INVESTIGATION OF DYNAMICAL EFFECTS IN THE SCATTERING OF ELECTRONS IN POLYCRYSTALLINE FILMS OF Al, Cu, Ag, AND Au FOR VOLTAGES BETWEEN 100 and 400 kV. Udalova, V. V.; Khitrova, V. I.; Pinsker, Z. G.; Fedotov, A. F. (Inst. of Crystallography, Moscow). Sov. Phys.-Cryst. (Engl. Transl.); 17: No. 4, 657-662 (1973).

Translated from Kristallografiya; 17: No. 4, 750-756(1972).

The experimental structure amplitudes of Al, Cu, Ag, and Au obtained from electron diffraction patterns of polycrystalline films taken at 100, 200, 300, and 400 kV are compared to values calculated using several approximations (kinematic, two-wave, and multiwave) for the theory of electron scattering in a crystal. It is shown that the use of extinction corrections improves the agreement of the experimental and calculated structure amplitudes in all of the cases investigated, with the role of these corrections being greater at 100 kV than at 400 kV. Consideration of multiwave interactions using dynamical potentials does not suffice, although in a number of cases it gives good results. (auth)

19026 SPECTRUM OF COMBINATION SCATTERING OF HEXAGONAL BORON NITRIDE. Babich, I. L. (Kiev State Univ.). Teor. Eksp. Khim.; 8: No. 5, 712-713(1972). (In Russian).

The combination scattering spectrum was obtained for polycrystalline hexagonal boron nitride using a conical cuvette. The halfwidth length which measured 1,370 cm^{-1} was discussed in relation to the literature data. (tr-auth)

19027 HEAT OF THE SEMICONDUCTOR–METAL PHASE TRANSITION IN V_2O_3. Khlyustov, V. G.; Borukhovich, A. S.; Perelyaev, V. A. (Inst. of Chemistry, Sverdlovsk, USSR). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 7, 1848-1849(Jan 1973).

Translated from Fiz. Tverd. Tela; 14: No. 7, 2142-2144(Jul 1972).

The thermal capacity C_p of V_2O_3 was measured between 120 and 190°K. The anomaly begins at ~150°K and ends at ~178°K, with the C_p maximum lying at 165.66°K. The anomaly corresponds to a first-order phase transition. The transition heat is calculated to be 1490 ± 10 J/mole or 310 kcal/mole, which corresponds to an anomalous part of the entropy of 9.0 ± 0.1 J/mole · degree. In the neighborhood of the phase transition, there is a sharp increase in the time required to reach thermal equilibrium. (DLC)

19028 INTERATOMIC POTENTIALS AND SIMULATION OF LATTICE DEFECTS. Battelle Institute Materials Science Colloquia, Seattle, Washington and Harrison Hot Springs, British Columbia, June 14–19, 1971. Gehlen, P. C.; Beeler, J. R. Jr.; Jaffee, R. I. (eds.). New York; Plenum Publishing Corporation (1972). 799p. $40.00. (CONF-710621).

The colloquim is devoted to a new field of materials science in which computers are used to simulate defects and cascades in crystal lattices. The thirty-six papers were presented in five sessions: introductory lectures on interatomic forces and defect calculations; interatomic potentials; simulation of point defects; line defects; surface defects; and volume defects. Besides the discussion following each individual paper, each of the last three sessions were followed by an agenda discussion, and two concluding agenda discussions were held on computer techniques and critical issues. Author and subject indexes are provided. Separate abstracts were prepared for three of the papers. (DLC)

For abstracts of individual papers see: 18994 through 18996.

19029 COMBINED BASIS FUNCTION METHOD FOR ENERGY BAND CALCULATIONS. Arbman, G. O. (Foersvarets Forskningsanstalt, Stockholm); Koelling, D. D. Phys. Scr.; 5: No. 6, 273-8(1972).

A method to calculate relativistic energy bands and wave functions is presented, in which rapidly converging basis sets are created from linearly combined RAPW functions. By constructing other basis sets, convergence of the band structure of complex materials (e.g., compounds) can be studied with a matrix of moderate size. Results of an application to fcc praseodymium show the usefulness of the method and indicate a considerable potential for future developments. (auth)

19030 BACKSCATTERING AND CHANNELING TECHNIQUES AS METHODS OF ANALYSIS OF SURFACES AND THIN LAYERS. Meyer, O.; Linker, G. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 4: No. 2, 29-36(1972). (In German).

Some recent results are given of backscattering of light ions ($^4He^+$) used for material analysis and for studying diffusion processes by application of low-energy accelerators and by fast pulsed reactions with semiconductor detectors proportional to energy (orientations, layers with ion implantation and amorphous layers, diffusion processes close to surfaces). (GF)

19031 INTERNATIONAL CONFERENCE ON PHONON SCATTERING IN SOLIDS. Conference Held at Paris, France, July 3, 1972. Albany, H. J. (ed.). Saclay, France; Centre d'Etudes Nucleaires de Saclay (1972). 402p. (In French and English). (CONF-720720).

Seventy-five papers were presented at the conference. They are grouped into seven sections entitled: phonon–phonon interactions, defect scattering, electron–phonon scattering, spin–phonon scattering, phase transition and magnon–phonon interactions, phonon scattering in noncrystalline materials, and interface effects. Five papers are abstracted for NSA. (DLC)

For abstracts of individual papers see: 18999–19002, and 19032.

19032 EFFECT OF SPIN-PHONON INTERACTION ON NEUTRON SCATTERING FROM LATTICE VIBRATIONS. Tani, K. (Kyoto Univ.). pp 314-17 of International Conference on Phonon Scattering in Solids. /Albany, H. J. (ed.). Saclay, France; Centre d'Etudes Nucleaires de Saclay (1972).

From International conference on phonon scattering in solids; Paris, France (3 Jul 1972). See CONF-720720.

A variation on conventional neutron-scattering theory is discussed. In the analysis of neutron scattering experiments from lattice vibrations, the effect of the force exerted on a phonon by spins is usually taken into account only through the frequency shift and the damping constant of the phonon. However, an additional contribution to the scattering cross section must be considered. It is shown that this additional contribution is proportional to the strength of the spin–phonon interaction squared, has anomalous temperature dependence contrary to the conventional cross section, and becomes appreciable near the critical point. (France)

19033 ANISOTROPIC POINT-SCATTERING LIFETIMES IN MOLYBDENUM WITH DILUTE TUNGSTEN IMPURITIES. Arko, A. J. (Argonne National Lab., Ill.); Mueller, F. M. Phys. Rev. Lett.; 29: No. 22, 1515-18(27 Nov 1972).

A detailed set of orbital Landau-level lifetimes of the third-band hole octahedron of molybdenum with 385 and 525 ppM tungsten im-

purities were measured using the de Haas–van Alphen effect. Measurements were taken in the two principal symmetry planes. Although these data themselves were similar in shape and showed substantial anisotropies, an inversion, using a new and rather simple technique, produced point-scattering rates which markedly increased such anisotropies. (auth)

19034 CONDUCTION ELECTRONS IN METALS. Azbel, M. Ya.; Kaganov, M. I.; Lifshitz, I. M. Sci. Amer.; 228: No. 1, 88-98(Jan 1973).

The quasi-particle concept, used in the last ten years or so to predict and explain a large number of physical phenomena, is surveyed here. In attempting to determine the dispersion law for quasi particles, it is preferable to start from the most general concepts of quantum mechanics and construct a theory of those phenomena in crystals and properties of crystals that are sensitive to the crystal's energy structure and, in particular, to the dispersion law for quasi particles. By comparing the predictions of the theory with experimental results, it is possible to reconstruct the energy structure of crystals from the dispersion laws. It is pointed out that the quasi particles help determine whether a crystal is an insulator, a semiconductor, a conductor, or a superconductor. (LMT)

19035 MAGNETIC AND MAGNETOSTRICTION PROPERTIES OF THE COMPOUND Tm_6Fe_{23}. Belov, K. P.; Nikitin, S. A.; Bisliev, A. M.; Savitskii, E. M. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 317-319(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 448-451(30 Oct 1972).

Results of a study of this compound are presented graphically as follows: (1) temperature dependences (in the interval 4.2 to 700°K) of the specific spontaneous saturation magnetization, of the coercive force, and of the susceptibility; and (2) magnetostriction as a function of magnetic field (up to 15 kOe) at temperatures 82 to 311°K. (LMT)

19036 INFLUENCE OF HEAT TREATMENT UPON THE LOW-TEMPERATURE HEAT CAPACITY OF PYROLYTIC GRAPHITE. Wostenholm, G. H.; Yates, B. (Univ. of Salford, Eng.). Phil. Mag.; 27: No. 1, 185-196(Jan 1973).

Measurements of the specific heat of two specimens of pyrolytic graphite are reported in the temperature range 4 to 70°K. Following deposition under identical conditions, one of the samples had been heat treated at 2975°C for 1 hour. In the case of both specimens, the lattice heat capacity at constant strain varied essentially as T^2 between approximately 5 to 60°K, though the effect of the heat treatment was to reduce the specific heat by approximately 20% over the greater part of this range. A representative set of results has been shown to agree well with the lattice dynamics reported by others. Although the effect of the heat treatment is consistent with an increase in c_{44}, attention is drawn to the desirability of conducting further experiments before unambiguous physical significance might be attached to explanations permitted formally by the lattice dynamics. (UK)

19037 MAGNETIC ANISOTROPY OF A SEMIHARD MAGNETIC ALLOY OF Co–Fe–Nb SYSTEM. Kassai, Makoto; Okada, Masanori; Sasaki, Tatsuji; Henmi, Zenzo (Fujitsu Labs., Kawasaki, Japan). Trans. Jap. Inst. Metals; 13: No. 6, 385-390 (Nov 1972).

The relationship between the crystalline texture and the magnetic anisotropy in the Co–12Fe–3Nb alloy cold-rolled by 96% reduction in area was investigated through the measurements of x-ray pole figures, hysteresis loops, and magnetic torque curves. It was found that the magnetic anisotropy of the alloy is due to the magnetic crystal anisotropy (K_1) and the induced magnetic anisotropy (K_u). The shape of hysteresis-loop depends on which anisotropy is prevailing; the perminvar type for $|K_u| \neq |K_1|$, the constricted curve or the rectangular curve for $|K_u| < |K_1|$; in the cold-rolled and annealed states, the direction of major easy magnetization is along the transverse direction; upon annealing at temperatures above 700°C, the direction of hard magnetization changes to that of minor easy magnetization; and the cold-rolling texture of this alloy is the "brass type" one, that is (110)[$\bar{1}$12]. This texture persists up to 900°C. The (111) peak intensity in the x-ray pole figure increases gradually as the annealing temperature rises. Consequently, the value of apparent crystal anisotropy constant increases gradually up to 750°C. When the annealing temperature is over 750°C, the apparent crystal anisotropy constant is -2.3×10^5 erg/cc. (auth)

19038 PROPERTIES OF SEMIHARD MAGNETIC ALLOYS OF THE Co–Fe–Nb SYSTEM. Okada, Masanori; Kassai, Makoto; Suzuki, Yuichi; Sasaki, Tatsuji; Henmi, Zeno (Fujitsu Labs., Kawasaki, Japan). Trans. Jap. Inst. Metals; 13: No. 6, 391-395 (Nov 1972).

The chemical-composition dependence of properties of high-Co–Fe–Nb semihard magnetic alloys was investigated. Magnetic properties, resistivity, Vickers hardness, x-ray diffraction, and thermal expansion coefficients were measured in the specimens annealed at 500 ~ 1100°C after cold drawing by 90~ reduction in area. The coercive force (H_c) of the specimen containing more than 2 wt % Nb was remarkably increased by annealing near 700°C and the value of the alloy with 4 wt% Nb reached about 30 Oe. More-over, a squareness ratio (I_r/I_{100}) higher than 0.90 and magnetization ($4\pi I_{100}$) about 16000 G achieved. The values of squareness ratio and remanences of specimens containing more than 15 wt % Fe in the cold-drawn state were low. However, the values increased with annealing temperature and reached over 0.90 and 14500 G by 700°C annealing, respectively. The crystal structure of Co–21 wt % Fe–3 wt % Nb alloy in the cold drawn state was bcc and transformed into the fcc phase by annealing above 900°C. (auth)

Moessbauer Effects and NMR

Refer also to abstract 18740.

19039 SYSTEMATICS OF MOESSBAUER ISOMER SHIFTS IN TRANSITION METALS. Wagner, F. E.; Wortmann, G.; Kalvius, G. M. (Univ., Garching, Ger.). Phys. Lett.; 42A: No. 7, 483-484(29 Jan 1973).

Moessbauer isomer shifts for ^{99}Ru, ^{193}Ir, and ^{197}Au as impurities in other transition metals are reported. Together with published data on ^{57}Fe, ^{181}Ta, and ^{195}Pt, these results reveal a systematic behavior of the electron densities at the nuclei of the impurities. Some of these features can be useful for the derivation of values for $\delta\langle r^2\rangle$ for new Moessbauer resonances. (auth)

19040 APPLICATION OF POSITRON EMISSION IN SOLID-STATE RESEARCH. Adam, Andras (Central Research Inst. for Physics, Budapest). Fiz. Szemle; 22: No. 10, 304-307 (Oct 1972). (In Hungarian).

The technique used for measuring the angular correlation between γ emissions in positron annihilation experiments was described. These measurements make it possible to study the anisotropy of the electron pulse distribution which in turn yields information on the actual shape of the Fermi surface. Collimators were used with the ^{22}Na and ^{64}Cu sources to ensure that only the 0.51-MeV γ rays emitted by the specimens reach the central portion of the NaI(Tl) crystal detector. The method was used to study the first-order magnetic phase transformation of FeRh. The angular correlation curves in the ferromagnetic and antiferromagnetic phase are presented. The transformation temperature was determined by a Thomson resistance bridge. It was concluded that the electron structure of FeRh does not change during the phase transfer. Experiments were also carried out to study positron annihilation in the color center of NaCl crystals; a qualitative model was developed to determine the time distribution in annihilation reactions induced by a laser beam. Further study of the dynamics of A centers is still in progress. (TTT)

19041 γ ANNIHILATION SPECTRUM IS TEMPERATURE INDEPENDENT. Faraci, G. (Univ., Catania, Italy); Pennisi, A. R.; Turrisi, E.; Schwengler, M.; Stelzer, K. Lett. Nuovo Cim.; 5: No. 1, 75-7(2 Sep 1972).

High-resolution energy spectra measurements were performed at 300, 77, and 4.2°K for the γ radiation of positrons annihilating in a lead single crystal. For each temperature, several spectra were taken that were compared both for the same and for different temperatures. The analysis did not show any variation with temperature. (MOW)

PHYSICS (THEORETICAL)

Refer also to abstracts 18251, 18526, 18529, 18791, 18848, 18850, and 18942.

19042 (SGAE-2054) NEUTRON SCATTERING: A METHOD FOR INVESTIGATION OF THE FLUID STATE OF MATTER. Eder, O. J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Physik-Institut). Nov 1972. 24p. (In German). Dep. NTIS (U. S. Sales Only).

Mathematically treated is the scattering of thermal neutrons as a tool for studying the liquid state of matter. In this state, microscopic molecular motion cannot be extrapolated from the dynamics of either solid bodies or gases. At the present time, no simple model exists for the liquid state, such as the ideal or Boltzmann's gas for the gaseous state, or the harmonic crystal for the solid state. The hard-core approximation explains many macroscopic and microscopic properties. A comprehensive theory of the liquid state, however, must take into account a more precise treatment of the potentials between particles. (HBG)

19043 NON-COMPACT GROUPS AND THE HARMONIC OSCILLATOR. Crubellier, A.; Feneuille, S. (CNRS, Orsay, France). pp 428-40 of Structure of Matter. /Wybourne, B. G. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1972).

From Symposium on the structure of matter; Christchurch, New Zealand (7 Jul 1971). See CONF-710733.

It is shown that it is possible to study the tensorial character in the orbital and quasi-spin spaces of spinless boson creation and annihilation operators. From this it is shown that in three dimensions the states of the harmonic oscillator can be studied according to their transformation properties with respect to the various groups of the chains. (JFP)

19044 GREEN'S-FUNCTION EQUATIONS OF THE SCHROEDINGER-PAULI TYPE IN THE CASE OF CONSTANT HOMOGENEOUS ELECTRIC AND MAGNETIC FIELDS. Kassandrov, V. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 3, 344-348 (1972). (In Russian).

A closed, analytical expression was obtained for a time-delayed Green's function equation of the Schroedinger-Pauli type in constant, homogeneous, and randomly oriented electric and magnetic fields. The statement of the problem and the presentation in the form of a series or integral of statistical Green's functions and their Fourier forms have been presented by previous authors for a magnetic and an electric field. The present author has previously developed the case of parallel electric and magnetic fields. (tr-auth)

19045 THREE-BODY PROBLEM. Lekner, J. (Cambridge Univ., Eng.). Proc. Cambridge Phil. Soc.; 73: No. 1, 177-182 (Jan 1973).

The ground state of a system of three interacting particles of equal mass is considered. An integro-differential equation is obtained for the optimum pair function f in the product wave function $\psi(123) = f(12)f(13)f(23)$. The solution for harmonic forces reproduces the known exact ground state. Approximate analytic solutions are obtained for inverse-square forces, and for a general force law in the semiclassical limit. (auth)

19046 TIME OPERATORS, PARTIAL STATIONARITY, AND THE ENERGY-TIME UNCERTAINTY RELATION. Eberly, J. H.; (Stanford Univ., CA); Singh, L. P. S. Phys. Rev., D; 7: No. 2, 359-362(15 Jan 1973).

The reciprocal time operator which is suggested by the notion of partial stationarity is shown to permit an unambiguous and nonsingular statement of the energy-time uncertainty relation. (auth)

19047 RELATIVISTIC QUANTUM MANY-BODY THEORY IN RIEMANNIAN SPACE-TIME. Bowers, R. L.; (Univ. of Texas, Austin); Zimmerman, R. L. Phys. Rev., D; 7: No. 2, 296-325 (15 Jan 1973).

A relativistic quantum many-body theory, which includes the strong interactions between elementary particles in curved space-time, is constructed. Using a generalized statistical-density operator, which incorporates the effects of gravitation as given by Einstein's field equations, as well as observables constructed from a generally covariant Lagrangian for matter fields, the definition of an N-point function of second-quantized matter fields is presented. The Yukawa coupling of a spinor field is then introduced. Coupled integral equations for the fermion and boson two-point functions in terms of the vertex function are given, which contain density and temperature effects in curved space-time; they are coupled to Einstein's equations through the expectation value of the energy-momentum density operator. Renormalization to effective masses and charge, as well as regularization, are discussed. The curved-space-time statistical-density operator is examined in the flat-space-time limit, and also in the nonrelativistic limit. The former agrees with previous work in relativistic statistical mechanics. The introduction of temperature and density as boundary conditions on flat-space-time N-point functions is carried out yielding a relativistic formalism, which may be applied to the calculation of such quantities as the equation of state of a superdense system of strongly interacting baryons. The nonrelativistic limit suggests a new approach to the statistical mechanics of Newtonian gravitation, in which such parameters as temperature become functions of coordinates. The relativistic flat-space-time limit is applicable to neutron stars at densities $\rho > 10^{15}$ g/cm^3 consisting of strongly interacting matter. (auth)

19048 RESTRICTIONS ON NONLOCAL HIDDEN-VARIABLE THEORY. McGuire, J. H.; Fry, E. S. (Texas A and M Univ., College Station). Phys. Rev., D; 7: No. 2, 555-557(15 Jan 1973).

In a recent experiment, Freedman and Clauser have found that Bell's inequality for local hidden-variable theories is violated by over six standard deviations. An inequality similar to Bell's for nonlocal hidden-variable theories is derived in which the hidden-variable density distribution of the particles measured is nonlocal, but where the detectors are contained within some finite volume. The measurement of Freedman and Clauser is used to put a lower limit on the nonlocality of the hidden-variable density distributions of the photons detected in their experiment. (auth)

19049 GREEN'S FUNCTION FOR THE MAXWELL EQUATIONS IN LAMINATED MEDIA. Magomedov, M. R.; Muradyan, M. M. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 3, 178-187(1972). (In Russian).

The solution of Maxwell's equations in laminated media for arbitrarily distributed external sources is obtained by the Green's function method. The case of periodic laminated media is considered in detail as the most important for applications. All the results are represented in a form convenient for application. As an example, fields produced in the normal passage of a uniformly moving charged particle through the laminated media as well as periodical laminated media of an arbitrary periodicity were calculated. (auth)

19050 SOLUTION OF COUPLED SQUARE WELL MODELS. Lovas, R. ATOMKI (At. Kut. Intez.) Kozlem.; 14: No. 3, 161-187(1972).

The analytical solutions of coupled-channels models consisting of two square wells, two two-stepped potentials, and three square wells, each coupled by potentials of the same type, are reported. These solutions are suitable for modelling both the scattering and the bound states of a system that resembles a nucleus. Calculations with these models concerning the form factors of direct reactions to unbound state were carried out. Their physical consequences have been published. Codes based on these solutions are outlined. The listing of one of the codes as well as its handling are presented. (auth)

19051 T-MATRIX THEORY FOR MANY-PARTICLE SYSTEM. Kuroda, Y.; Kurihara, Y. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1758-1759(Nov 1972).

As is well known, a T-matrix method is one of the most powerful approaches to study a quantum system such as liquid or solid He, where an interparticle potential includes a strong repulsive core. Recent work on solid He suggested a more extensive application of the method than usual. In this paper it is examined in a more general way, and an approach to include two-body correlation effects more precisely is considered. (RWR)

19052 REARRANGEMENT COLLISIONS. Zakhar'ev, B. N.; Fenin, Yu. I.; Shmonin, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 163-169 of Structure of Nuclei. Vienna; International Atomic Energy Agency (1972).

See STI/PUB-305.

One of the basic problems of nonrelativistic quantum scattering theory is the development of effective methods to solve the Schroedinger equation for different many-particle systems. Two principles concerning the solution of differential equations in partial derivatives in an unrestricted domain are considered first, the principle of limit absorption and the principle of limit amplitude. A method is then proposed in which the scattering wave function is constructed by utilizing the expansion in the set of the same basic functions as for the bound-state problem. In this method for

describing reactions of general type (with rearrangement of particles and division of a system into three and more parts) it is not necessary to subtract from ψ divergent waves with unknown amplitudes. (1 figure) (RWR)

19053 PROBABILITY UNCERTAINTY OF QUANTAL OBJECTS. Majernik, V. (Inst. of Physics, Bratislava). Acta Phys. Austr.; 35: No. 4, 371-377(1972).

The probability uncertainty of a quantal object, expressed by its Shannon's entropy, is determined and shown to be a function of the imaginary part of its principal function only. The dependence of the time change of the probability uncertainty on other physical parameters of a quantal object, representing an important relation in the physical and the communication sciences, was derived. Especially, it was shown that there exists a simple mathematical relation between the time change of probability uncertainty of a quantal object and its physical current. (auth)

19054 ACCURATE SOLUTIONS FOR FERMI SYSTEMS WITH AN ASYMPTOTICALLY LARGE NUMBER OF PARTICLES. Simenog, I. V. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1921-1923(Nov 1972). (In Russian).

Fundamental solutions in the limit of a large number of particles for Fermi systems with monotonic potentials between particles were adduced. In the case examined for fundamental states a single-particle approximation of Hartree and Thomas–Fermi type was obtained. (tr-auth)

19055 GENERALIZATION OF THE MODIFIED PERTURBATION EXPANSION FOR THE DENSITY MATRIX IN PATH-INTEGRAL FORMALISM. Goovaerts, M. J.; Broeckx, F. (State Univ., Antwerp). Physica; 62: No. 2, 267-277(15 Nov 1972).

Performing a generalization of the modified perturbation expansion, the Born series for path integrals is deduced entirely within Feynman's formalism for the nonrelativistic quantum mechanics. The starting point is the evaluation of the path integral corresponding to the δ-function potential. The method is extended to systems consisting of N nonidentical particles. In an appendix the convergence of the expansions is discussed. (auth)

19056 ALGEBRAIC SOLUTION OF THE SCHROEDINGER EQUATION FOR A CLASS OF VELOCITY-DEPENDENT POTENTIALS. Barut, A. O.; Bornzin, G. L. (International Centre for Theoretical Physics, Triests, Italy). Lett. Nuovo Cim.; 6: No. 5, 177-180(3 Feb 1973).

An algebraic method was previously indicated for solving the nonrelativistic Kepler problem with or without magnetic charges using the Lie algebra of the dynamic group 0(4,2). It is shown that this method is readily extended by a simple transformation of the algebra so that an entire class of velocity-dependent potentials may be solved. In addition, the relation between the Runge–Lenz vector as usually defined for the Schroedinger equation and that which arises naturally in the algebraic solution of the equation is derived. (LBS)

REACTOR TECHNOLOGY

Power Reactor Development

Refer also to abstracts 17325, 17726, and 19260.

19057 (DEU–72-4) SOME ASPECTS OF THE FAST BREEDER DEVELOPMENT IN GERMANY AND IN THE BENELUX COUNTRIES. Seetzen, J.; Woite, G. (Bundesministerium fuer Bildung und Wissenschaft, Bonn (West Germany)). Jun 1970. 22p. (In German). INIS.

The most important problems of the fast breeder development such as the power plant, fuel element design, fuel cycle, and construction of the fast test reactor are discussed. This is followed by a time-table considering the appropriate measures to be taken in the years 1971 to 1975. The economic aspects, including current generation costs, plutonium inventory, yield criterion, and strategy calculations of fast breeder reactors are described. (INIS)

19058 (JAPFNR-73) FAST BREEDER REACTOR DEVELOPMENT AT PNC, JAPAN. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Dec 1972. 7p. (PNC-N-72-36). Dep. NTIS (U.S. Sales Only).

The program for fast breeder reactor development at PNC is described. The program includes construction of the JOYO experimental reactor, design of the MONJU prototype reactor, reactor physics research, development of components and equipment, development of control instrumentation, sodium technology development, fuels and materials development, and safety research. (JWR)

19059 (KFK-1663) EUROPEAN GCFR PROGRAM PLANS. Dalle Donne, M.; Wirtz, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut Fuer Neutronenphysik und Reaktortechnik). Aug 1972. 27p. (EUR-4845). Dep. NTIS (U.S. Sales Only).

In 1968 two specialist teams were set up by ENEA to evaluate the merits of steam and gas as alternative coolants to sodium for a fast breeder reactor. Following the conclusions of the ENEA Working Team, seven European countries, which were performing work in the field of gas-cooled fast reactors, joined together in the so-called "Zürich-Club" to coordinate their governmental efforts in this field and exchange information. Subsequently, 14 European companies set up the Gas-cooled Breeder Reactor Association in Brussels. In the following two years the GBRA produced two assessment studies of a GCFR both with 1000 MW(e). The first one based on steel clad, mixed oxides vented fuel pins, the second one on silicon carbide coated fuel particles. In Germany a study on the feasibility and the economics of a GCFR was performed. The study came to the conclusion that the GCFR with steel clad vented fuel pins was the type with the minimum amount of required further development work. This reactor offered a performance comparable to that for the sodium breeder. The two German nuclear centers have agreed a four-year 6.5 million dollar program (1971-74) whose main items are: A joint study Karlsruhe-Siemens-Jülich of the safety aspects of 1000 MW(e) GCFR with steam turbine cycle, integrated primary helium circuit and vented steel clad fuel pins; and a joint irradiation Jülich-Siemens-Karlsruhe of a 12 vented pin bundle in the Belgian reactor BR 2 with a surrounding driving fuel region capable to produce a relevant fast flux. (auth)

19060 (NP–19635) ANNUAL REPORT, 1970. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 110p. (In Spanish). Dep. NTIS (U. S. Sales Only).

19061 (RDT INDEX-1-73) INDEX OF RDT STANDARDS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 31p. RSO.

The current bimonthly listing of 263 reactor standards issued through January 31, 1973 is presented. (auth)

19062 (STI-PUB-300(Vol.5)) PEACEFUL USES OF ATOMIC ENERGY. VOLUME 5. PROCEEDINGS SERIES. PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE HELD IN GENEVA, SWITZERLAND, SEPTEMBER 6–16, 1971. (International Atomic Energy Agency, Vienna (Austria)). May 1972. 478p. (In several languages). (CONF-710901–Vol.5). IAEA $14.00.

From 4th International Conference on the Peaceful Uses of Atomic Energy; Geneva, Switzerland (6 Sep 1971).

Papers are presented on the development of breeder and advanced converter reactors. A separate abstract for each paper was included in NSA Volume 25, Issues 16 and 22. (HDR)

19063 DEVELOPMENT AND CHARACTERISTICS OF THE GERMAN HIGH TEMPERATURE REACTOR. Mueller, H. W. (Hochtemperatur-Reaktorbau GmbH, Mannheim, Ger.); Schoening, J. J. Brit. Nucl. Energy Soc.; 12: No. 1, 95-105(Jan 1973).

The experimental high temperature reactor AVR 15, has been operating since 1967; the THTR 300 is under construction, and the HTR 1160 is at the planning stage. AVR 15 has provided the basic experience for this reactor concept. THTR 300 will provide the experience for large high temperature reactors. This prototype nuclear power plant represents an essential step forward on the way towards realization of the high temperature reactor line. The Uentrop reactor site conditions are favorable for both construction and operation. The construction period is largely determined by the introduction of new technologies, e.g., for the prestressed concrete pressure vessel and for the shut-down and refueling system. Nuclear safety features of the power plant are particularly attractive due to the low excess reactivity of the reactor, the low radioactivity content of the individual circuits, and due to the complete integration of the helium primary circuit and the core in the prestressed concrete pressure vessel. (auth)

19064 IMPROVEMENTS IN AND RELATING TO GAS COOLED NUCLEAR REACTORS. Allbeson, K. F.; Birch, W.; Billsborough, R.; Derbyshire, J. (to Nuclear Power Group Ltd.). British Patent 1,294,087. 25 Oct 1972. Filed 8 Nov 1968.

A gas cooled reactor is described with a solid reactor core enclosed in the pressure vessel, the core being supported on the floor of the vessel by refractory material. Exit for gas coolant from the core is provided by passages in the refractory material which connect gas passages in the core to a gas space outside the core. A neutron shield is incorporated between the core and the refractory material. Various methods of assembling blocks in columns to form the core which is supported on separate columns of blocks made of refractory material are described. The cross-section of the refractory material blocks is such that a series of passages for gas flow are produced. (UK)

19065 BONN WILL SPONSOR RESEARCH AND TECHNOLOGY BY 6.5 BILLION GERMAN MARK. The Fourth Atomic Energy Program Gives New Impetus to the Reactor Development. Welt (Hamburg); No. 249, 13p. (1972). (In German).

The plans for the fourth German atomic energy program are reviewed. This program will support the development of a thorium fueled high-temperature reactor (THTR), the sodium-cooled fast breeder, and a reactor for a container merchant ship. Other activities promoted by this program include uranium enrichment by various methods as well as safety and radiation protection problems. (GF)

19066 PRELIMINARY DESIGN (2nd) OF THE EXPERIMENTAL MULTIPURPOSE HIGH TEMPERATURE REACTOR. Tsunoda, Roykichi (Fuji Electric Co. Ltd., Tokyo). Fuji Jiho; 45: No. 6, 559-568(Jun 1972). (In Japanese).

Results of the second preliminary design of a 50 MW experimental high temperature reactor, which is at the design and developmental stage in JAERI, are summarized. The design outlet and inlet temperatures of the coolant gas are 1000°C and 400°C, respectively. Two loops are connected to the reactor, one for generating reducing gas and the other for the test operation of a high temperature heat exchanger and a gas turbine. The layout of the plant systems within a container and the main characteristics of the plant are shown. The present design and technological problems of the core structure, control rods and their driving mechanism, fuel handler, operation modes, the high temperature heat exchanger, emergency core cooling system, water vapor dumping system, the reactor container, instrumentation, and control systems are described. (JA)

19067 JAPAN'S REVISED LONG-RANGE PROGRAM. At. Jap.; 16: No. 6, 10-27(Jun 1972).

The Japanese AEC has completed a draft of the revised Long-range Program on Development and Utilization of Atomic Energy. This was required due to the recent accelerated rate of atomic energy utilization, especially power generation, and environmental pollution caused by thermal power plants. In the revised form, great emphasis is placed on the protection of environment as well as on the safety of facilities. Based on current planning, nuclear power generation will be 32,000 MWe by 1980, and will reach as high as 100,000 MWe in 1990. Aiming at a stabilized supply of nuclear fuel, enrichment of uranium in Japan is stressed. Other salient points are the development of container-type nuclear ships and multi-purpose HTGRs. (JA)

19068 OT NAUCHNOGO POISKA K ATOMNOI PROMYSHLENNOSTI. Sovremennye Problemy Atomnoi Nauki i Tekhniki v SSSR. Izdanie Vtoroe Dopolnennoe. (From Scientific Re-

search to the Atomic Industry. Contemporary Problems in Atomic Science and Technology in the USSR. Second edition, revised.). Petros'yants, A. M. Moscow; Atomizat (1972). 351p.

Uses of atomic energy and nuclear power in the USSR are described. Small-scale nuclear-powered modular devices and low-power atomic devices powered by isotopes are discussed. Research institutes concerned with atomic energy, radiation technology, and nuclear reactors are discussed. Thermonuclear research, nuclear powered ships, and the disposal of radioactive wastes are considered in individual chapters. References lacking. (KSW)

19069 NUCLEAR POWER IN AUSTRALIA. Casa, A. F.; Perilli, M. L.; Sansone, M. M. Com. Naz. Energ. Nucl., Notiz.; 18: No. 10, 47-52(Oct 1972). (In Italian).

The present situation and predicted development of nuclear power in Australia are discussed in three articles, concerning respectively: the energy picture and nuclear plant prospects (with special reference to the planned Jervis Bay nuclear power plant); the Atomic Energy Commission; and the main developments in uranium prospecting. (auth)

Physics and Core Engineering

19070 (COO-3060-4) ECONOMICS OF FUEL DEPLETION IN FAST BREEDER REACTOR BLANKETS. Brewer, S. T.; Mason, E. A.; Driscoll, M. J. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Nov 1972. Contract AT(11-1)-3060. 342p. (MITNE-123). Dep. NTIS.

A fast breeder reactor fuel depletion-economics model was developed and applied to a number of 1000 MW(e) LMFBR case studies, involving radial blanket-radial reflector design, radial blanket fuel management, and sensitivity of energy costs to changes in the economic environment. Choice of fuel cost accounting philosophy, e.g. whether or not to tax plutonium revenue, was found to have significant effect on absolute values of energy costs without, however, distorting design rankings, comparative results, and irradiation time optimization. A single multigroup physics computation, to obtain the flux shape and local spectra for depletion calculations, was found to be sufficient for preliminary design and sensitivity studies. The major source of error in blanket depletion results was found to be the assumption of a fixed flux shape over an irradiation cycle; spectrum hardening in the radial blanket with irradiation is of minor importance. The simple depletion-economics model was applied to several 1000 MW(e) LMFBR case studies. Advantages of a moderating reflector were found to increase as blanket thickness was reduced. For a 45 cm radial blanket, a beryllium metal reflector offered little improvement, in blanket fuel economics, over sodium; for a 15 cm blanket, beryllium increased net blanket revenue by about 60%. An improvement of about 30% in net blanket revenue resulted when each radial blanket annular region was assumed to be exposed to its own local optimum irradiation time. Optimum radial blanket irradiation time and the net blanket revenue (mills/KWHe) at this optimum were found to be approximately linear in the unit fuel cycle costs, i.e. fabrication and reprocessing costs ($/kgHM) and fissile market value ($/kg). (84 references) (auth)

19071 (EIR-229) MOLTEN CHLORIDES FAST BREEDER REACTOR. Reactor Physics Calculations. Ligou, J. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1972. 39p. Dep. NTIS (U. S. Sales Only).

19072 (EURFNR-1027) FAST BREEDER PROJECT. FIRST QUARTERLY REPORT, JANUARY 1—MARCH 31, 1972. Hueper, R. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany)). Jun 1972. 244p. (KFK-1272/1; EUR-4844). Dep. NTIS

Work performed under United States—Euratom Fast Reactor Exchange Program.

The development program for liquid sodium cooled fast breeder power reactors in Germany during January to April 1972 is reviewed. Physics calculations and PuO_2-UO_2 fuel element radiation testing results are presented. (DCC)

19073 (JAPFNR-72) FAST REACTOR CORE DESIGN OPTIMIZATION. Inoue, Kotaro; Kobayashi, Tomofumi (Hitachi, Ltd., Tokyo (Japan)). Apr. 1972. 49p. (PNC-J-202-72-15). Dep. NTIS (U.S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

Large fast reactor cores of 1000 MW and 1500 MW electric power have been optimized concerning the fuel cycle cost using the "Fast Reactor Design Optimization System." No striking difference appears between the 1000 MW class and the 1500 MW class besides the required enrichments and number of core fuel assemblies which is almost in proportion to the thermal power. Sensitivity analysis of the 1000 MW reactor core has been practiced as well as the optimization. The coolant temperature rise through the reactor and the criterion of the coolant maximum velocity have an important effect on the optimum design point and the fuel cycle cost. The fuel cycle cost of the optimized core is lower by 0.09 mill/kWh than that of the 1000 MW core obtained from a scale-up of MONJU by increasing the number of fuel assemblies and changing the enrichments. (auth)

19074 MERIT INDEX FOR GAS-COOLED REACTOR HEAT TRANSFER. Melese-d'Hospital, D. (Gulf General Atomic Co., San Diego, CA). Nucl. Sci. Eng.; 50: No. 1, 83-5(Jan 1973).

A simple merit index has been derived to compare potential improvements in gas-cooled nuclear reactor cores, such as artificial surface roughening of the fuel rods. For given pumping-to-thermal power ratio, the core output per unit heat transfer area is proportional to the merit index $(N^3/f)^{1/3}$. Stanton number, or dimensionless surface heat transfer coefficient, is N_s, and f is the friction factor. (auth)

19075 FAST REACTOR CORE DEFORMATION DUE TO STAINLESS STEEL SWELLING AND THERMAL BOWING WITH IRRADIATION ENHANCED AND THERMAL CREEP. Ohmae, Kenichi; Ohtsuki, Atsushi; Kaneto, Kunikazu (Hitachi Ltd., Japan). Nucl. Eng. Des.; 23: No. 1, 86-106(1972).

In order to establish a technique which will properly account for the LMFBR core deformation under various reactor operating conditions, two separate computer programs have been developed, and coupled together. The first of the two, "FEMCRP," is a finite element creep analysis code for a long, straight, hexagonal tube. The second program owes its origin to BOW-V developed by ANL, but was later modified considerably to include the effect of stainless steel swelling. The computer program, HICODEM, is the cross between the two. It can analyze the equilibrium configuration of the core consisting of fuel subassemblies of various burnup histories, with corresponding degree of swelling and creep. The code can assume a mechanical clamping on the periphery of the core during the power operation, and, after a desired length of time, it can bring the entire core to the refueling temperature and unclamp the constraint, the resultant equilibrium core configuration being successively obtained. The results can be obtained by the ordinary digital print out and/or by the X-Y plotter as the vertical cross section of the core. HICODEM code has been successfully checked out against available literature and against itself by taking different computational paths. The code consists of about 6,000 source cards, and takes about 20 minutes on a HITAC 5020F (or IBM 360) for a typical computation simulating one entire refueling cycle (about 146 days for Monju). (auth)

19076 1160 MW HIGH TEMPERATURE NUCLEAR POWER STATION PROJECT. Shilling, W. F. (Gulf General Atomic Europe, Zurich) Stoelzl, D.; Tegen, W. Atomwirt., Atomtech.; 17: No. 9-10, 520-4(1972). (In German).

Based on experiences gained from the 300 MW(e) thorium high temperature reactor, which is now under construction, the present project for a 1160 MW(e) nuclear power plant with high temperature reactor is described. This plant will be constructed within the framework of the fourth German atomic program as a demonstration power plant. The reactor core consists of block-shaped fuel elements. All significant reactor components are integrated within a prestressed concrete container constructed in the Pod-mode. The reactor is surrounded by a reactor safety container. The high temperature reactor excels with respect to a high degree of environmental compatibility. This fact results especially from the thermal efficiency with associated smaller demands for cooling water as well as from the minimal amount of activity release in all cases of normal operations and disturbances. (tr-auth)

19077 FURTHER DEVELOPMENT OF THE PRESSURE WATER REACTOR IN THE BRD. Braun, W. (Siemens AG, Erlangen, Ger.). Atomwirt., Atomtech.; 17: No. 9-10, 483-6(1972). (In German).

Like other proven reactor systems, further development of the Siemens pressurized-water reactor does not aim at a fundamentally new construction but at consolidation of the available techniques into a higher degree of efficiency and economy. This aim includes continuous improvement and simplification of components and systems, advancement of safety-technical development, and reduction of fuel cycle cost through exhaustion of the potential for core development. Moreover, the power parameters of the fuel assembly are undergoing further improvements. Special efforts are directed toward increased reactor safety as well as toward enhanced compatibility with the environment. (tr-auth)

19078 FURTHER DEVELOPMENT OF THE BOILING WATER REACTOR IN THE BRD. Voigt, O. (AEG-Telefunken, Frankfurt

am Main). Atomwirt., Atomtech.; 17: No. 9-10, 488-91(1972). (In German).

Further development of the boiling water reactors is based on previously realized and operationally proven techniques. It aims at both higher availability and economy of installation. Especially emphasized is the adherence to one line of construction. Only when several parallel lines of development are concluded will the basic line be replaced by a new one. Independent of power size, important components in each construction line are mutually exchangeable. Standardization of components in the construction line creates a high potential for development of future installations of this type. (tr-auth)

19079 FAST BREEDER AT WEISWEILER. Deut. Forschungsdienst, Sonderber. Kernenerg.; 15: No. 22, 107-10 (1970). (In German).

The Weisweiler project is a 300 MW(e) prototype nuclear power station with a sodium cooled fast reactor. A brief description of the site and the design of the plant is given. (INIS)

19080 THERMAL SPECTRUM INDEXES AND RELATIVE CONVERSION RATIOS IN D_2O MODERATED, UO_2–ThO_2 FUELLED LATTICES. Carmina, P.; Guardini, S.; Tassan, S.; Vitanza, C. (CCR-EURATOM, Ispra, Italy). Energ. Nucl. (Milan); 19: No. 10, 607-19(Oct 1972).

Thermal spectrum indexes and relative conversion ratios were measured by the activation method for a large number of lattices of 19-rod and 37-rod clusters of UO_2-ThO_2 fuel, D_2O moderated and with various coolants. The experimental results obtained were used to test the 39-group transport code HEROIC and associated cross-sections library. 22 references. (auth)

19081 ACCURACY IN REACTOR NUCLEAR DESIGN. Hirota, Jitsuya (Japan Atomic Energy Research Inst., Tokai); Nagayama, Satoshi; Otake, Iwao; Iijima, Shungo; Inoue, Teruji. Nippon Genshiryoku Gakkaishi; 14: No. 1, 21-38(Jan 1972). (In Japanese).

The present status of accuracy in nuclear design of three types of reactors is reviewed by specialists in each field. Trends and targets of improving the accuracy are also discussed. (1) Light water reactors. As basic nuclear data, ENDF/B is mainly used. For the calculation of neutron spectra, MUFT and SOFOCATE are widely used for PWRs, while GAM and THERMOS are used for BWRs. Agreement between neutron calculations and measurement is fairly good at low temperature, while at operating temperature, usable measurements are very limited. Thus accumulation of reliable operating measurements and improvement of instrumentation techniques will play important roles for the reliable prediction of operating reactor characteristics. (2) Gas cooled reactors. MAGNOX reactors, AGRs and HTGRs are included in this category. An outline of the design codes, ARGOSY, WIMS, GGC and DELIGHT (developed at JAERI) is given. Results of comparison between calculations and measurements are also explained. Conclusions are that better accuracy in the nuclear data of F.P. nuclides is needed. (3) Fast Reactors. Based on the experience in the theoretical analysis of FCA mock-up experiment for JOYO, the status of accuracy in nuclear design is made clear. Differences in effective multiplying rate, control rod reactivity, power distribution, doppler reactivity, sample reactivity and sodium void reactivity are summarized. Differences among various data sets are also explained with emphasis on the need for more universal sets. The mock-up experiment is very valuable for adjusting the design calculations. This situation will be true for prototype and commercial fast breeder reactors. (Japan)

Control Elements, Systems, and Instrumentation

Refer also to abstract 17300.

19082 APPLICATION OF ACOUSTIC DIAGNOSTICS IN NUCLEAR REACTOR OPERATION AND DEVELOPMENT. Barclay, F. J. (United Kingdom Atomic Energy Authority, Dounreay, Eng.); Hale, J. C.; Ledwidge, T. J.; Burton, E. H.; Jones, C. H. Ind. At. Spatiales; 16: No. 3, 44-50(May 1972).

In the environment near a nuclear reactor core, control and instrumentation techniques are difficult. Acoustic energy can be channelled to standard commercial transducers located away from the radiation and heat of the core using simply constructed, or even fortuitously occurring waveguides. These may be solid rods or liquid filled tubes. The outputs from the transducers may be analyzed by ear or by means of spectrum analyzer. The application of acoustic techniques to liquid systems, boiling systems and gas cooled systems is discussed in a general way. Some detailed experience of acoustics in pressurized water reactors, boiling water reactors, gas cooled reactors and liquid metal cooled fast reactors (Dounreay reactor) is presented. (France)

19083 MATHEMATICAL MODEL OF A CONTROL ROD DROP. Donis, J. M. (Burns and Roe, Inc., Oradell, NJ); Goller, Herbert. Nucl. Eng. Des.; 23: No. 1, 107-20(1972).

A mathematical model of a control rod drop for a pressurized water reactor is presented. A hybrid computer program is used to solve the non-linear differential equations which describe the model. The computer solution is briefly described. The rod drop time computed by using the model is compared with available data from experimental results for a rack and pinion control system. Additional applications of the mathematical model are described and presented. (auth)

Containment Systems, Shielding, Waste Processing, and Radiation Protection

Refer also to abstracts 17141, 17142, 17144, 17237, and 17922.

19084 (JAPFNR-68) EVALUATION OF THE TWO-DIMENSIONAL SHIELDING CODE FOR A FAST REACTOR SHIELD DESIGN AND ITS APPLICATION. Tanaka, Y.; Suzuki, I.; Otani, N. (Kawasaki Heavy Industries Ltd., Kobe (Japan)). Mar 1972. 137p. (PNC-J-213-72-3-1). Dep. NTIS (U.S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

The evaluation of the two-dimensional shielding code RASC-2D for a typical fast reactor shield design was performed and its applicability was established. For the main shield of the prototype fast reactor MONJU, a comparison between an exact transport theory calculation and a removal-diffusion theory calculation was performed and it was found that the difference between the exact transport calculation and the removal-diffusion calculation could be made small by adjusting removal cross sections within a proper limit. On the basis of the above improvement, a removal cross-section adjusting code was added to the RASC-2D code system. A capture and activation gamma source calculation code based on a two-dimensional a-few-group neutron flux was developed and was added to the RASC-2D code system. As the application of the extended RASC-2D code, the analysis of the MONJU main shield was done. (auth)

Cooling Systems

Refer also to abstracts 17195 and 19313.

19085 (ANL/EBR-65) EBR-II RADIOACTIVE SODIUM CHEMISTRY LOOP (RSCL). Haroldsen, G. O.; Livengood, C. L. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Aug 1972. Contract W-31-109-eng-38. 36p. Dep. NTIS.

The EBR-II radioactive sodium chemistry loop (RSCL) was designed and constructed to provide a facility for demonstration and testing of prototypal sodium samplers and on-line impurity monitors in coolant representative of liquid-metal-cooled, fast breeder reactors. The RSCL is a pipe circuit for circulating primary-reactor-system sodium. Five pairs of supply and return lines branching off the main circuit furnish continuously flowing sodium to each of five subsystems consisting of the on-line monitoring devices and associated equipment. The facility permits conducting multiple experiments simultaneously with a minimum of interaction among them. An in-depth safety evaluation, especially of fire safety, commensurate with the expected experimental program was included in the design effort. (auth)

19086 (CONF-701074-6) COMPUTATIONAL METHODS OF EVALUATING THE EMERGENCY STATE OF A SODIUM LOOP DURING PIPING BREAKDOWN IN A "SODIUM–WATER" STEAM GENERATOR. Poplavskii, V. M.; Bagdasarov, Yu. E.; Leonchuk, V. N. Translated from pp 474-503 of Proceedings of the Scientific-Technical Conference on Atomic Power, Fuel Cycles, and Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. I. 26p. Dep. NTIS.

Presented are computational methods for evaluating the effects of the reaction of sodium with water directly in the reaction zone, and also on various sections of the sodium loop during considerable destruction of heat-transfer pipes in a steam generator. A description is given of a physical model of the process, used to construct computational procedures, the maximally possible emergency pressures and temperatures in a steam generator directly in the reaction zone are analyzed, and a method of calculating the change of parameters of the reaction in the course of time in the zone of pipe destruction with consideration of the compressibility of the coolant is presented. Methods are presented for calculation of hydrodynamic effects in the sodium loop of the installation and the emergency systems of the steam generator. Simplified methods of calculating the emergency parameters are explained, the use of which

is convenient in the stage of rough determination of the main characteristics of the liquid metallic system. The calculated values, obtained by different methods, are compared with the experimental. (auth)

19087 (CONF-721112-5) CONSTITUTIVE EQUATIONS FOR INELASTIC ANALYSES OF LIQUID-METAL FAST BREEDER REACTOR SYSTEM COMPONENTS. Liu, K. C.; Pugh, C. E.; Greenstreet, W. L. (Oak Ridge National Lab., Tenn.). [nd]. 37p. Dep. NTIS.

From American Society of Mechanical Engineers Winter meeting; New York, NY (26 Nov 1972).

Constitutive relations selected for use in performing inelastic analyses of structures for use in early liquid-metal-cooled, fast breeder reactor (LMFBR) systems are described. Components of these systems are to operate at temperatures where creep is important and under time-varying temperature and loading conditions. The materials considered are Types 304 and 316 stainless steels. Small deformation behavior is assumed, and it is postulated that the total strain tensor can be decomposed into time-independent (elastic and plastic) components and time-dependent (creep) components. Thus, constitutive equations for elastic-plastic and for creep behavior are discussed separately. Results from short-time stress–strain tests at various temperatures are examined and essential features are discussed in the context of mathematical modeling requirements. Existing mathematical theories of plasticity are reviewed in terms of describing the observed behaviors, which include nonlinear kinematic hardening type characteristics. It is shown that extensions to the theories are required to model the features of interest, and promising approaches for modification are indicated. Finally, constitutive equations for interim use are outlined. In the case of creep behavior, both primary and secondary stage creep deformations are of importance. An equation-of-state type formulation is adopted for interim use in this case. Various hardening rules are examined, and the strain-hardening rule is shown to approximate behavior observed from uniaxial texts. Modifications to this rule are required when stress reversals are encountered. Auxiliary rules for this type loading are developed and described for the uniaxial case. These latter rules are then generalized for combined stress conditions in which near-radial loadings are encountered. Experimental studies for examining important unknowns related to creep response are outlined, and directions for research related directly to theory development are proposed. Interactions between essentially time-independent permanent (plastic) strains and time-dependent (creep) strains can be significant and represent an area in need of concentrated study. Manifestations of such interactions are discussed briefly. (auth)

19088 (GEAP-13898-1) LMFBR PUMP DEVELOPMENT PROGRAM. First Quarterly Report, June–August 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Sep 1972. Contract AT(04-3)-893. 20p. Dep. NTIS.

The work performed under the LMFBR Pump Development Program will develop the technology required for the design and fabrication of reliable pumps suitable for use in the primary cooling system of LMFBR demonstration plants. Work planning has been carried out to formulate the organizational structure of the program and to lay the basis for the government fiscal year (GFY) 1973 effort. Work has been initiated on supporting studies to form the basis for preparation of ordering data for the procurement of a prototype pump. (auth)

19089 TRITIUM GENERATION IN THE COOLANT-MODERATOR OF PRESSURIZED WATER REACTORS. Hornyik, Karl (Oregon State Univ., Corvallis). Nucl. Sci. Eng.; 49: No. 3, 247-54(Nov 1972).

The generation of tritium from the $^{10}B(n,2\alpha)^3H$ reaction involving boric acid in the coolant-moderator of PWRs is studied. First, the total amount of tritium produced by this process during a core cycle is calculated for the case of base load operation assuming separability of the neutron flux into space, energy, and time modes as well as a linear decrease of the boric acid concentration in compensation for burnup effects. Subsequently, analytic solutions to this problem are obtained for square-wave load-following assuming both total and one particular mode of partial compensation of the reactivity transients due to xenon poisoning by boric acid. The limitation to load following due to practical limitation of the dilution rate is observed. The solutions are expressed in terms of commonly available plant parameters and are presented in graphical form as a function of characteristics of the load following program. The significance of the analysis is illustrated by means of a numerical example; details of the xenon-transient analysis are included as an appendix. (auth)

19090 MONITORING OF PRIMARY CIRCUIT IN STEAM GENERATORS AT NUCLEAR POWER PLANTS USING WATER-MODERATED WATER-COOLED REACTORS. Fedchenko, T. K.; Il'khman, A. A. At. Energ. (USSR); 34: No. 1, 39-40(Jan 1973). (In Russian).

The overall flow diagram for a nuclear power plant is considered from the viewpoint of the optimum placement of seven radiation monitoring points. These points were arranged in the primary steam generation loop to monitor the concentration of noble gas radioactivity, γ-radiation, β-radiation of ^{16}N, and the activity of the blow-off water from the steam generator. The sensitivities of the methods employed were 5×10^{-10} Ci/l of noble gas, 0.01 μCi/sec for γ, and 3 counts/sec for β radiation. (KSW)

19091 STUDY OF THE EFFECT OF PRESSURE ON THE DNB IN A CROSSED ROD MATRIX WITH R-113 COOLANT. Jaikrishnan, K. R.; Rohrer, W. M. (Univ. of Pittsburgh). Nucl. Eng. Des.; 22: No. 2, 244-51(1972).

Earlier investigations of departure from nucleate boiling (DNB) in a crossed rod matrix show that such a geometry holds promise as a possible configuration for the fuel core in a highly compact and efficient nuclear reactor. This investigation is an extension of Coffield's work, further studying the effect of pressure. The fluid used was R–113 ($C Cl_2 F–C Cl F_2$). The coolant pressures for the rest were 75, 100 and 125 psig. The subcooling was 40, 60, and 80°F. Mass velocities ranged from 1.0×10^5 to 3.5×10^5 lb/hr-ft^2. An increase in critical heat flux of the order of 10,000, 15,000 and 20,000 BTU/hr-ft^2 was obtained for a 25 psi increase for 40, 60, and 80°F subcooling respectively. An empirical equation correlated the critical heat flux q''_{crit} to within ± 25.0%. (auth)

19092 COVER-GAS BUBBLES IN RECIRCULATING SODIUM PRIMARY COOLANT. Winterton, R. H. S. (Central Electricity Generating Board, Berkeley, Eng.). Nucl. Eng. Des.; 22: No. 2, 262-71(1972).

The cover gas used over sodium in a fast reactor is more soluble in hot sodium than in cold. Consequently the cover gas will have a tendency to dissolve in the hot sodium leaving the core, and come out of solution in the form of gas bubbles in the cooler part of the circuit. The equilibrium number of gas bubbles is calculated on the assumption of no entrainment at the free surface. Consideration of the mass transfer processes at the free surfaces and in the intermediate heat exchanger is used to give the rate at which gas bubbles are formed. The equilibrium number of bubbles depends on how readily they rise to the free surface and escape. The size of the bubbles used in these calculations is found using a theory previously developed. As an example the theory is applied to the Prototype Fast Reactor. At full power the radius of the bubbles is estimated to be 50 to 100 μm, and the number of bubbles entering the core between 10^4 and 2×10^5 m^{-3}. The effect on boiling and detection is discussed. (auth)

19093 STEAM–WATER SEPARATION IN THE BOILING WATER REACTOR. PART II. CONSTRUCTION OF STEAM–WATER SEPARATOR AND STEAM DRYING APPARATUS. Pollak, G. (AEG Telefunken, Frankfurt am Main). Konstr. Elem. Method.; 8: No. 11, 441-3(1971). (In German).

A description of the steam separator and the steam drying apparatus and the installation of these components in the reactor containment system is given. An outline of the manufacturing process is followed by the discussion of such problems as to what extent these parts will be detachable for fuel element changes, and what requirements are to be fulfilled regarding both rigidity and quality. (INIS)

19094 STEAM–WATER SEPARATION IN THE BOILING WATER REACTOR. PART I. THE STEAM–WATER SEPARATION AS PART OF THE COOLANT CIRCULATION. Loehr, E. (AEG Telefunken, Frankfurt am Main). Konstr. Elem. Method.; 8: No. 11, 439-41(1971). (In German).

The steam–water separation process in the boiling water reactor of AEG-Telefunken is described. Details are given as to the components used and to the design criteria to be observed according to the present state of technology. It is shown that the cyclone separators which have been developed by AEG are able to meet the requirements of the steam–water separation even for very large nuclear power plants, including a sufficient amount of spare capacity. (INIS)

19095 CHOICE OF MATERIALS IN THE CONSTRUCTION OF THE COOLING CIRCUITS AND TANKS OF NUCLEAR POWER PLANTS. Geffroy, B. (Electricite de France, Ecuelles). pp 47-51 of Choice of Metallic Materials. Paris; Masson (1972). (In French).

From 13th conference on metallurgy; Saclay, France (25 Jun 1970). See CONF-700672.

The cooling tanks and circuits of nuclear reactors possess a number of general characteristics (size of the installations, complexity, utilization over a number of years, and fluid coolants of

various degrees of corrosivity, etc.), which must be considered in selecting the most suitable materials for their construction. The choice of materials in the different stages of research and development of a project is examined in view of these considerations. (FR)

19096 MECHANICAL SODIUM PUMPS FOR LIQUID METAL-COOLED FAST BREEDER REACTORS. Shimoyashiki, Shigehiro (Hitachi Ltd., Ibaraki, Japan); Sagawa, Norihiko; Ito, Yoshio; Suzuki, Akira. Ponpu Kogaku; 7: No. 11, 743-7(Nov 1971). (In Japanese).

Sodium circulating pumps are classified into electromagnetic pumps and mechanical pumps. The electromagnetic pumps have an advantage of no leak, but efficiency is low. The mechanical sodium pumps are vertical pumps with a long shaft. Bearings are hydrostatic bearings lubricated with the sodium itself, in order to avoid sodium contamination. A shaft seal mechanism is necessary to prevent fire and spread of radioactivity resulting from a sodium leak. There are two types of shaft seals, the freeze seal type and the free liquid surface type and the latter is employed in general recently. Austenitic stainless steel is used for the primary system, while for the secondary system, Cr–Mo steel is used sometimes. The shafts and bearings are made of a combination of austenitic stainless steel, Stellite, Hastelloy, etc. The pumps must be preheated to about 98°C, the melting point of the sodium, prior to charging the sodium. A small mechanical sodium pump of such type was manufactured for trial. Its specifications are as follows, flow rate 1 m^3/min, total head 40 m Na, speed 2400 rpm, motor power 30 KW, design temperature 450°C, and speed control by electromagnetic coupling. On the basis of experiences and results obtained by design, manufacture, trial operation, disassembly after the operation, and cleaning of the pump, development of large sized and usable pumps is in progress at present. The problems are associated with the sodium-lubricated bearings, shaft seals, and rigidity of the pumps. (Japan)

19097 STEAM–WATER SEPARATION IN THE BOILING WATER REACTOR. PART III. THEORETICAL AND EXPERIMENTAL DETERMINATION OF THE OPERATING BEHAVIOR OF CYCLONES FOR STEAM–WATER SEPARATION. Simon, U. Konstr. Elem. Method.; 8: No. 11, 443-8(1971). (In German).

The steam-water mixture emerging from the core of a boiling water reactor has to be separated into the two phases, steam and water. The separation is performed using cyclones and driers. The mass throughput and steam content at the cyclone inlet are largely variable according to reactor load requirements. The cyclone has to produce sufficient separation values under all load conditions. Its separation behavior is derived in dependence of different operating states. Experimental results affirm the theory. (INIS)

19098 DETERMINATION OF BUBBLE-SIZE DISTRIBUTION IN A BWR. Uga, Takeo (Japan Atomic Energy Research Inst., Tokai). Nucl. Eng. Des.; 22: No. 2, 252-61(1972).

A procedure for determining the bubble-size distribution in an operating natural circulation BWR utilizing a digital type void meter and a bubble speed meter is described in detail. The relationship between void signal and bubble size is established, subject to justifiable assumptions, in the form of an integral equation. With this equation, the average bubble diameter and the average bubble volume can be derived from the normalized histogram with respect to penetration lengths of the bubbles. The bubble-size distributions found in the riser and in the downcomer have solved some of the steam separation problems in the plenum, where the recirculation flow changes from upwards to downwards. (auth)

Fuel Systems and Components

Refer also to abstracts 17729, 17872, and 19167.

19099 (ANL–7873) RADIOACTIVITY OF EBR-II COMPONENTS. I. EXAMINATIONS IN FY 1971. Smith, C. R. F. (comp.) (Argonne National Lab., Ill.). Sep 1972. Contract W-31-109-eng-38. 80p. Dep. NTIS.

The following components from the primary system of EBR-II were examined for radioactivity during FY 1971: (1) irradiated-fuel-monitor thimble; (2) primary pump No. 1; (3) intermediate heat exchanger; (4) pump duct from the fuel-element-rupture detector; (5) the cold trap in the primary purification system; and (6) specimens from the SURV-3 materials-irradiation subassembly. From the secondary system, the evacuation tube of the intermediate heat exchanger was also studied for radioactivity. Besides ^{22}Na, which was readily removed by cleaning, the principal radionuclides found in this study (more than a month after reactor shutdown) were ^{54}Mn, ^{137}Cs, ^{60}Co, and ^{182}Ta. Manganese-54 was the principal radionuclide found on surfaces that had been submerged in sodium. Cesium-137 was the principal radionuclide found on surfaces exposed to the cover gas. Comparison of the ratios of ^{137}Cs/^{22}Na in deposits with those found in bulk sodium before reactor shutdown confirmed previous reports of ^{137}Cs segregation from bulk sodium. The ^{137}Cs/^{22}Na ratio on deposits found in the cover-gas region were as much as 100–400 times that found in bulk sodium before shutdown. Some ^{51}Mn, ^{58}Co, and ^{60}Co activities have been identified in oxide deposits and on metals in the cover-gas region. (auth)

19100 (ANL-Trans-917) DETERMINATION OF THE BURN-UP AND OF THE HEAVY ISOTOPE AND FISSION PRODUCT COMPOSITION OF THERMAL AND FAST REACTOR FUELS. Vidal, R.; Robin, M.; Devillers, C. Translated for Argonne National Lab., Ill., from Paper 4A of Panel on the Behaviour and Chemical State of Fission Products in Irradiated Fuel, Vienna, 7–11 August 1972. 14p. (CONF-720843–13). Dep. NTIS.

Methods for calculating the burnup and heavy isotope and fission product composition of thermal and fast reactor fuels are described. 12 references. (auth)

19101 (CONF-720578-1) METALLURGICAL ASPECTS OF THE FAST BREEDER REACTOR AND HIGH TEMPERATURE GAS COOLED REACTOR. Board, J. A. (British Nuclear Design and Construction Ltd., Whetstone (England)). 1972. 75p.

From International Nickel power conference; Lausanne, Switzerland (May 1972).

The development programs for the fast breeder reactor and high temperature reactor in W. Europe and the U.S.A. are summarized and the materials problems associated wtih these advanced designs are outlined. A detailed discussion is given of several areas of particular metallurgical interest. The required properties of cladding alloys are reviewed with particular attention being given to problems of irradiation embrittlement and to void formation in fast neutron fluxes. The corrosion of materials by molten sodium is discussed with reference to the FBR primary circuit and the choice of material for boiler tubing is considered with reference to steam leak conditions. In the case of HTR materials, the most important factor is the behavior of candidate alloys in a high temperature impure helium atmosphere. The effect of long-term exposure to this atmosphere on mechanical properties is discussed in detail in the light of requirement for both the steam cycle HTR and the direct cycle gas turbine HTR. (149 references) (auth)

19102 (CONF-721109–15) FAST REACTOR FUEL PROCESSING. Ferguson, D. E.; Lotts, A. L. (Oak Ridge National Lab., Tenn.). 1972. Contract W-7405-eng-26. 20p. Dep. NTIS.

From International conference on nuclear solutions to world energy problems; Washington, DC (12 Nov 1972).

Progress on the development of chemical processing and recycle fuel fabrication technology for LMFBR fuel is reviewed. (auth)

19103 (GEAP–10028-43) SODIUM-COOLED REACTORS FAST CERAMIC REACTOR DEVELOPMENT PROGRAM. Forty-Third Quarterly Report, May–July 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Aug 1972. Contract AT(04-3)-189. 155p. Dep. NTIS.

FAST CERAMIC REACTOR — fuel elements for, design characteristics of plutonium oxide (PuO_2)–uranium oxide (UO_2) test
— fuel elements for, fission product release from failed stainless steel clad plutonium oxide (PuO_2)–uranium oxide (UO_2), (E)
— fuel elements for, failure thresholds for, (E)
— coolant loss conditions in, effects on core of, (E/T)
— fuel elements for, performance of stainless steel clad plutonium oxide (PuO_2)–uranium oxide (UO_2), (E)
FISSION PRODUCTS — release from failed stainless steel clad plutonium oxide (PuO_2)–uranium oxide (UO_2) fuel rods, (E)
NEUTRONS, FAST — effects on mechanical properties of stainless steel, (E)
REACTOR FUEL ELEMENTS — performance of liquid sodium cooled stainless steel clad plutonium oxide (PuO_2)–uranium oxide (UO_2), (E)
— fission product release from failed stainless steel clad plutonium oxide (PuO_2)–uranium oxide (UO_2), (E)
STAINLESS STEEL — radiation effects on mechanical properties of, fast neutron, (E)

19104 (GEAP-13823-3) LMFBR HOT CELL REFUELING COMPONENT TESTS. Third quarterly report, July–September 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Oct 1972. AT(04-3)-189. 42p. Dep. NTIS.

The work performed is directed to demonstration of acceptable performance, service life, repair, and maintenance techniques of the generic components which could be used in a hot cell re-

fueling system. This will be accomplished through environmental development tests of specifically designed equipment, such as the fuel transfer container, and commercially available equipment, such as the fuel transfer container, and commercially available equipment, which may be modified for hot cell use. Thermal and stress analysis of the fuel transfer container was performed and planning was begun on the testing facility. Conceptual design work was completed on Test 3, solidified sodium properties, and Test 5, electrical power and control components, and detail design work was initiated on both tests. (auth)

19105 (KFK-1665) CALCULATION OF THE STRESS AND STRAIN IN TWO FOLD CONTINUOUS PRISMATIC BODIES WITH EXAMPLE OF CALCULATION FOR A RIBBED FUEL TUBE. **Krieg, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Oct 1972. 142p. (In German). Dep. NTIS (U. S. Sales Only).**

The stress distribution of elastic prismatic bodies with uniform loads along their axis is described by a partial differential equation. One way of solution is the representation by an infinite power series, the homogeneous parts of which is known from literature. The particular solution, however, has to be formulated in a suitable way, since a problem with given initial strains has to be solved. For instance, thermal strains represent such initial strains. In the homogeneous parts of solution certain constants appear, which are determined by the boundary conditions and possibly by the Michell conditions. For a given accuracy the calculation of these constants reveals severe numerical difficulties in cases where the cross section contours significantly differs from a circle. The successful treatment of this problem is described. The analytical results are compared with photoelastic experiments. On the basis of this linear elastic treatment the solution is extended to allow for nonlinear behavior (creep). An incremental procedure is employed, so that for each small time step an elastic stress distribution as well as corresponding increments of creep strains can be calculated. The initial strains for an elastic stress solution at a certain time are represented by the creep strains accumulated up to this time. Applying the described theory two computer programs were developed: EVA1 (linear elastic material) and EVA2 (nonlinear material). Both programs are particularly suited for the stress analysis of nuclear reactor fuel pins with integrated axial ribs. Various case studies are included showing the effects of internal pressure, thermal strains, swelling as well as irradiation induced creep. 54 references. (auth)

19106 (ORNL-4760) GAS-COOLED REACTOR AND THORIUM UTILIZATION PROGRAMS. Annual Progress Report for Period Ending September 30, 1971. **Kasten, P. R. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 188p. Dep. NTIS.**

CESIUM— release from irradiated coated particle fuels
FISSION PRODUCTS— transport in gas cooled reactor cooling systems
PLUTONIUM OXIDES PuO_2— PuO_2–UO_2, radiation testing of coated particle fuels
PRESSURE VESSELS— stress analysis for prestressed concrete
REACTOR FUEL ELEMENTS— radiation testing of gas cooled thorium oxide (ThO_2)–uranium oxide (UO_2) coated particle
— radiation testing of plutonium oxide (PuO_2)–uranium oxide (UO_2)
REACTOR FUELS— reprocessing of coated particle thorium carbide (ThC_2)–uranium carbide (UC_2) and thorium oxide (ThO_2)–uranium oxide (UO_2)
— fabrication of coated particle thorium carbide (ThC_2)–uranium carbide (UC_2) and thorium oxide (ThO_2)–uranium oxide (UO_2)
— fission product release from irradiated coated particle, effects of annealing on
— recycle of high temperature gas cooled, development program for
REACTORS, BREEDER— fuel elements for gas cooled, radiation testing of plutonium oxide (PuO_2)–uranium oxide (UO_2)
REACTORS, FAST— fuel elements for gas cooled, radiation testing of plutonium oxide (PuO_2)–uranium oxide (UO_2)
REACTORS, GAS-COOLED— development of high temperature, during September 1970 to September 1971
— fuel elements for high temperature, development and radiation testing of thorium oxide (ThO_2)–uranium oxide (UO_2)
— fuels for high temperature, reprocessing and fabrication of coated particle thorium carbide (ThC_2)–uranium carbide (UC_2) and thorium oxide (ThO_2)–uranium oxide (UO_2)
— pressure vessels for high temperature, development of prestressed concrete
— fuel elements for fast breeder, radiation testing of plutonium oxide (PuO_2)–uranium oxide (UO_2)
THORIUM CARBIDES— ThC_2–UC_2, reprocessing of coated particle fuels
— ThC_2–UC_2, fabrication of coated particle fuels
THORIUM OXIDE ThO_2— ThO_2–UO_2, radiation testing of coated particle fuels
— ThO_2–UO_2, reprocessing of coated particle fuels
— ThO_2–UO_2, fabrication of coated particle fuels
URANIUM CARBIDES— ThC_2–UC_2, reprocessing of coated particle fuels
— ThC_2–UC_2, fabrication of coated particle fuels
URANIUM OXIDES UO_2— ThO_2–UO_2, radiation testing of coated particle fuels
— ThO_2–UO_2, reprocessing of coated particle fuels
— ThO_2–UO_2, fabrication of coated particle fuels
— PuO_2–UO_2, radiation testing of coated particle fuels (DCC)

19107 (RDT-E-6-19-T(8-72)) CORE RADIAL REFLECTOR FOR SODIUM COOLED REACTORS. **(Division of Reactor Development and Technology (AEC), Washington, D. C.). Aug 1972. 18p. RSO.**

The requirements for the fabrication, quality assurance, packaging and delivery of core radial reflector assemblies are described. The Ordering Data establishes specific requirements for a particular radial reflector assembly. The purpose of the radial reflector assemblies is to maximize the core flux by reducing the radial neutron leakage. This standard applies to radial reflector assemblies for use in a liquid metal cooled reactor vessel. (auth)

19108 (RT/EC-(72)3) ITALIAN MARKET AND INDUSTRIAL PROSPECTS FOR NUCLEAR REACTOR FUEL CYCLE SERVICES. **Ambrosini, G.; Cicognani, G.; Comellini, O.; Valant, P.; Venditti, P.; Zironi, I. (Comitato Nazionale per L'Energia Nucleare, Rome (Italy)). 23 Oct 1972. 143p. (In Italian). Dep. NTIS (U. S. Sales Only).**

On the basis of ENEL's forecasts regarding the development of nuclear power in Italy until 1990, with extrapolations up to 2010, the evolution of the domestic market for the main nuclear reactor fuel cycle services is evaluated. In connection with similar estimates concerning the Western European market, and taking into account certain cost functions for the above mentioned services, a series of considerations on the development of Italian industry in the nuclear fuel cycle field is discussed. (auth)

19109 (UJV-2915-R) CONTRIBUTION TO THE FUEL CYCLE PROBLEM IN FAST POWER REACTORS. **Kujal, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Jaderneho Vyzkumu.). 1972. 17p. (In Czech). Dep. NTIS (U. S. Sales Only).**

The model of fissile and fertile material management in a fuel cycle of a fast power reactor is described. The reactor includes a cylindrical multizone core and axial and radial blankets. Charging and discharging is treated as a discontinuous process with a constant time step between two fuel cycles. The initial composition of fresh fuel elements is the same during the lifetime of a reactor. A burn-up study is carried out in two dimensional r-z geometry. A short code description and some numerical results for a fast convertor similar to the BN-350 reactor are included. (auth)

19110 (WCAP-3385-31) SAXTON PLUTONIUM PROJECT QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1972. **Caye, T. E. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). Nov 1972. Contract AT-(11-1)-3044. 52p. Dep. NTIS.**

Work completed on the Saxton Plutonium Project during the period January through March 1972 is reported. The main objective of the program is to develop information concerning the utilization of plutonium enriched fuels in pressurized water reactors. The program includes design, fabrication, operation, and post-irradiation examination of a partial plutonium core. Results on core III operations and evaluation of core III fuel for the period are presented. (JWR)

19111 (WCAP-8030) APPLICATION OF MODIFIED SPACER FACTOR TO L GRID TYPICAL AND COLD WALL CELL DNB. **Motley, F. E.; Cadek, F. F. (Westinghouse Electric Corp., Pittsburgh, Pa.). Oct 1972. 33p.**

Test data for "L" mixing vane grids from a typical and a thimble coldwall cell test section and test data from a previously completed "L" grid typical cell test section were analyzed using the modified spacer factor. This factor was developed for "R" mixing vane grid typical cells and extended to cold wall cells. A correction factor of .986 must be applied to the "L" grid, to bring the predicted heat flux, using the W-3 correlation with the "R" grid modified spacer factor, into agreement with the measured "L" grid DNB heat flux. (auth)

19112 LAMINAR- AND SLUG-FLOW HEAT TRANSFER CHARACTERISTICS OF FUEL RODS ADJACENT TO FUEL SUB-ASSEMBLY WALLS. Hsu, C.-J (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng.; 49: No. 3, 398-404(Nov 1972).

Multiregion heat transfer analyses, based on both laminar and slug flows, have been performed to explore the heat transfer characteristics of the rods located in the corner and edge regions of LMFBR nuclear fuel subassemblies. By adopting physical parameters of practical interest, the rod-average Nusselt numbers of these rods were calculated for equilateral triangular arrays of rods having pitch-to-diameter ratios in the range $1.05 \leq P/D \leq 2.00$. A mathematical scheme is presented for determining the laminar velocity field which, in this case, constitutes a mixed boundary-value problem specified in a domain of irregular shapes. For the special cases of peripherally uniform temperature or uniform heat flux at the outer wall of the cladding, rod-average Nusselt numbers were also calculated and compared with those for central rods. (auth)

19113 INVESTIGATION OF AN ANALYTICAL MODEL FOR PARALLEL FLOW INDUCED ROD VIBRATIONS. Ohlmer, E.; Russo, S.; Schwemmle, R. (EURATOM, Ispra, Italy). Nucl. Eng. Des.; 22: No. 2, 272-89(1972).

An analytical model describing the vibrations of a rod structure under axis-parallel fluid flow as well as the response to the driving pressure fluctuation field over the rod length was experimentally investigated. In particular the influences of a simplifying hypothesis in the analytical model were considered. The tests, performed with a single rod test facility in water flow, have given satisfactory results not only under ideal flow conditions but also when the flow structure was disturbed by pump vibrations or other loop influences. Measurements of the pressure difference fluctuations on the rod surface have given some characterizing data for the pressure field in the investigated flow geometry. (auth)

19114 CHOICE OF MATERIALS FOR NUCLEAR REACTOR CORES. Weisz, M. (CEN de Saclay, Gif-sur-Yvette, France). pp 147-8 of Choice of Metallic Materials. Paris; Masson (1972). (In French).

From 13th conference on metallurgy; Saclay, France (25 Jun 1970). See CONF-700672.

The current choice of materials for reactor core components depends upon the resistance of these materials to the mechanical stresses to which they will be subjected. Creep fatigue and swelling are studied. (FR)

19115 SWELLING OF STEELS IN THE CORES OF FAST NEUTRON REACTORS: MECHANICAL AND THERMAL SOLUTIONS. Leduc, J. (CEN de Cadarache, Saint-Paul-les-Durance, France). pp 149-57 of Choice of Metallic Materials. Paris; Masson (1972). (In French).

From 13th conference on metallurgy; Saclay, France (25 Jun 1970). See CONF-700672.

The swelling of steels in the cores of fast neutron reactors as a result of neutron irradiation is a function of temperature, fluence, neutron flux spectra, and probably the flux intensity. The deformation of fuel pins and free assemblies is calculated using values for the swelling determined from preliminary measurements made with the Rapsodie assemblies. Various methods have been studied for designing the cores of fast neutron reactors to withstand the swelling, assuming the validity of the order of magnitude value derived from the calculations. A series of calculations and trials were carried out in order to determine the behavior of Phenix if a swelling of the steel structure were to occur. Several solutions were studied in order to ensure the functioning of the core in spite of the swelling. (FR)

19116 SWELLING OF STEELS IN THE CORES OF FAST NEUTRON REACTORS: METALLURGICAL ASPECTS. Malkin, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 159-65 of Choice of Metallic Materials. Paris; Masson (1972). (In French).

From 13th conference on metallurgy; Saclay, France (25 Jun 1970). See CONF-700672.

The swelling of steels in the cores of fast neutron reactors can produce geometrical variations in the fuel assemblies leading to significant limitations in the combustion rate. This swelling is associated with the formation of cavities in the metal, which are due to the regrouping of the vacancies produced by neutron collisions. The high flux levels found in fast piles (some 10^{15} neutrons/cm^2xsec) lead to precipitation by nucleation and growth mechanisms. The swelling of the material depends upon external factors (instantaneous flux, spectral characteristics, temperature, and time) and in addition upon the composition. (FR)

19117 EXAMPLES OF THE POSSIBILITIES OF A BURST SLAG DUE TO A SLIGHT DEFORMATION: FUEL ELEMENT CLUSTERS. Petrequin, P. (CEN de Saclay, Gif-sur-Yvette, France). pp 181-6 of Choice of Metallic Materials. Paris; Masson (1972). (In French).

From 13th conference on metallurgy; Saclay, France (25 Jun 1970). See CONF-700672.

Two types of cladding materials envisaged for the HWGCR(CO_2) fuel elements were studied: Be and Zr–Cu alloy. In the case of Be, the presence of thermal stresses induces the growth of He bubbles (n,α reaction) and the rupture of grain boundaries. In the case of the Zr–Cu alloy, the presence of surface oxygenated layers with various expansion coefficients gives rise to stresses during thermal cycles; and the subsequent fissuration of the material. (FR)

19118 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Cowen, H. C. (to United Kingdom Atomic Energy Authority). British Patent 1,295,251. 8 Nov 1972. Filed date 30 Jul 1969. 1p.

Reference is made to fuel element sheathing materials for CO_2-cooled reactors. It has been found that, under some operating conditions, spalling of oxides from stainless steel sheaths occurs, but that a coating of Cu, Ag, Au, Rh, Ir, Ru, or Re, or alloys of these metals, reduced or possibly suppressed entirely this effect. It is also thought that such coatings will provide noncatalytic surfaces and thus reduce C deposition. The coatings may be applied by electroplating to a thickness of about 0.0005 in. Diffusion between the sheath and coating may be prevented by providing a diffusion barrier between the two as, for example, by preoxidizing the sheath or providing a precoating of a non-diffusible metal such as Mo or W. (UK)

19119 ESTIMATION OF THE MAXIMUM PERMISSIBLE BURNUP OF URANIUM CARBIDE FUEL PINS FROM THE ASPECT OF FUEL-CLAD COMPATIBILITY UNDER IN-PILE SIMULATED CONDITIONS. Nishio, Gunji; Watanabe, Hitoshi; Shimokawa, Junichi (Japan Atomic Energy Research Inst., Tokai). Nucl. Eng. Des.; 22: No. 2, 326-33(1972).

The maximum permissible burnup of a uranium carbide fuel pin from the aspect of its compatibility with stainless steel cladding bonded with sodium is estimated. The in-pile simulated condition is used. It is considered that the decarburization of hyperstoichiometric uranium carbide is governed by the dissolution, into sodium, of carbon atoms from UC_2 precipitating in the UC matrix; the decarburization rate depends on the temperature gradient in the fuel. The degree of carburization of the cladding tube, which governs the lifetime of a fuel pin, is determined by the flux of carbon atoms from the carbide fuel into sodium. The calculation shows that for a system of the carbide fuel containing 4.9 wt % carbon and AISI 304 stainless steel cladding, the maximum burnup is only 37,000 MWD/T at linear power 1000 W/cm, and 55,000 MWD/T at 500 W/cm, when the threshold carbon content of the stainless steel due to carburization is as large as 0.7 wt %. Therefore, a carbide fuel containing a relatively large amount of dicarbide seems to be not suitable for a fast breeder reactor. (auth)

19120 AGR FUEL PRODUCTION ENGINEERING. Edwards, D. R. (British Nuclear Fuels Ltd., Springfields). J. Brit. Nucl. Energy Soc.; 12: No. 1, 27-33(Jan 1973).

A description is given of the development of plant to fabricate fuel elements for civil AGRs. Studies were directed toward establishing efficient continuous fabricating procedures, integrating fully automatic inter-process handling, optimizing plant layouts, deriving quality control limits and developing suitable automatic gauging machines, while rationalizing economically realizable fuel quality in accord with fuel designers' needs. The development of process units is reviewed, process control being introduced at all difficult stages, while methods were evolved for recovering and re-employing sound components from rejected fuel pins. Finally, production plant overall efficiencies exceeding 98% were consistently demonstrated, at process rates exceeding 600 tonnes per year of finished fuel elements. (auth)

Operation and Economics

19121 OPTIMAL REFUELING POLICY OF LIGHT WATER MODERATED REACTOR. Kiyose, Ryohei; Suzuki, Atsuyuki (Tokyo Univ.). Tokyo Daigaku Kogakubu Fuzoku Sogo Shikenjo Nenpo; 30: 255-62(Sep 1971). (In Japanese).

The optimization of refueling policy of light water moderated reactors is investigated. In particular, the problem of minimizing consumption of fresh fuel throughout plant life is solved by applying linear programming. It is assumed that the reactor core is divided into zones and the nuclear performance of each zone can be described by the average of burnup of each fuel assembly. The feasibility of this assumption is shown by a three-dimensional

burnup calculation. By using the model, the fuel loading scheme at each stage can be determined completely in reasonable computing time. (auth)

Safety and Siting

Refer also to abstracts 17244, 17685, and 19259.

19122 (ANL–7951) VENUS-II: AN LMFBR DISASSEMBLY PROGRAM. Jackson, J. F.; Nicholson, R. B. (Argonne National Lab., Ill.). Sep 1972. Contract W-31-109-Eng-38. 154p. Dep. NTIS.

An improved version of the VENUS fast-reactor disassembly computer program is described. Denoted as VENUS-II, it is a two-dimensional coupled neutronics-hydrodynamics program that calculates the dynamic behavior of an LMFBR during a prompt-critical disassembly excursion. The mathematical model is described completely, emphasizing a number of new options and improvements. The basic assumptions and limitations of the model are discussed. Several new models being developed to extend the applicability of VENUS-II to milder excursions are also presented. These models, although not currently available as standard options in the code, will be made available after further testing and refinement. Finally, a complete users' guide for the program is included. (auth)

19123 (CONF-691061) ADVANCES IN SAFETY MEASURES FOR NUCLEAR POWER PLANTS. Colloquium Held in Hamburg, 27–28 October 1969. (Technischer Ueberwachungs-Verein e.V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Translation of report IRS-T–18. 240p. Dep. NTIS.

Safety aspects of power reactors and ship propulsion reactors are analyzed. Separate abstracts for each of the papers in the original language have been previously included in NSA under the following abstract numbers: 25: 48134; 25: 48215-22; 25: 48287; and 25: 48325. (DCC)

19124 (KFK–1515) ENVIRONMENTAL EXPOSURE BY RADIONUCLIDES IN GASEOUS AND LIQUID EFFLUENTS FROM NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Aurand, K.; Ruf, M.; Schikarski, W.; Schwibach, J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Feb 1972. 14p. (In German). INIS.

The effects on the environment of radioactive effluents from normally operating nuclear power plants in the Federal Republic of Germany are analyzed. The current licensing requirements are discussed in view of the national and international guidelines and regulations on such effluents. The contribution to the radiation burden of individual power plants via both gaseous and liquid effluent is calculated from measured and estimated data. This contribution is extrapolated for the increasing power requirements of an expanding economy. The results show that for the foreseeable future, up to the year 2000, the expected radiation burden to the population will be small relative to the natural radiation burden. (INIS)

19125 (ORNL–4835) REPORT OF THE CLINCH VALLEY STUDY, MAY 15–JUNE 2, 1972. Auxier, J. A.; Chester, R. O. (eds.) (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 69p. Dep. NTIS.

A number of topics are discussed which affect the handling of an accidental radioactivity release from a nuclear power plant. Principal attention is given to those matters that decrease the threat to the population surrounding the site of the power plant. Recommendations are made to improve existing emergency plans. Procedures and methods are listed which have proved useful in handling other types of emergencies and appear to have use during a radioactivity release. Also discussed are emergency control centers, construction modifications to the nuclear power plants, chemical prophylaxis, and improvised respiratory protection. (auth)

19126 (ORNL-TM–4030) ORNL NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROGRAM BIMONTHLY REPORT FOR SEPTEMBER–OCTOBER 1972. Non-LMFBR Programs. Cottrell, W. B. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 123p. Dep. NTIS.

The accomplishments during September and October in the research and development program are summarized. Much of this work is in general support of water-cooled power reactor technology, including LOFT and industry programs, and reflects current safety problems, such as blowdown heat transfer studies. Other major projects include experimental investigations of the attachment of nozzles to shells and the implementation of joint AEC-PVRC programs on heavy-section steel technology and nuclear piping, pumps, and valves. Several projects are also conducted in support of the high-temperature gas-cooled reactor (HTGR). Seismic considerations of particular significance in nuclear plant design are evaluated in the seismic program. Several of the above projects are also directly related to another major undertaking, the AEC's standards program, which entails development of engineering safeguards and the establishment of codes and standards for government-owned or -sponsored reactor facilities. The recent activities of the Nuclear Safety Information Center (NSIC) and the Nuclear Safety journal in behalf of the nuclear community are also discussed, Of particular interest in both of these activities is the emphasis on environmental effects. Starting with this issue our LMFBR safety studies are reported in a separate document. (auth)

19127 ANALYSIS OF THE COOLANT BEHAVIOR FOLLOWING FUEL FAILURE AND MOLTEN FUEL-SODIUM INTERACTION IN A FAST NUCLEAR REACTOR. Cronenberg, A. W.; Fauske, H. K.; Eggen, D. T. (Argonne National Lab., IL). Nucl. Sci. Eng.; 50: No. 1, 53-62(Jan 1973).

As part of the liquid-metal fast breeder reactor (LMFBR) safety program, the consequences of a hypothetical molten-fuel release into sodium coolant following fuel pin failure(s) must be evaluated, in order that design constraints can be established to maximize the safety and minimize the economical penalties of such an event. An attempt to interpret the voiding rates obtained from an in-pile, fuel-failure experiment in the TREAT reactor in terms of a molten fuel-coolant interaction is described. Results indicate that it is not only possible to reduce in-pile data to a workable form, but also to obtain representation of loop conditions for simple geometries. The analysis has been successful in reproducing the experimental voiding history in a selected TREAT experiment. It is further shown that the formation of condensate at cold boundaries significantly reduces the amount of energy imparted to the expanding vapor bubble, which in turn limits the extent of the thermal-to-mechanical energy conversion process. It is important to account for this effect when extrapolating in-pile results to reactor conditions. (auth)

19128 SOME AUTOCATALYTIC EFFECTS DURING EXPLOSIVE POWER TRANSIENTS IN LIQUID METAL COOLED, FAST BREEDER, NUCLEAR POWER REACTORS (LMFBRs). Webb, Richard Eugene. Columbus, Ohio; Ohio State Univ. (1972). 267p. University Microfilms Order No. 72-21,029.

Thesis.

Superprompt critical power excursions during liquid metal fast breeder reactor accidents which result in explosions are studied theoretically for possibilities of autocatalytic behavior. Many phenomena which conceptually suggest autocatalysis are considered briefly; but only two are treated in detail: (1) the implosion of a possible transverse gap in the core at the beginning of core disassembly (explosion); and (2) the explosive expansion of the fuel rods during the predisassembly phase of a power excursion, which in effect collapses the coolant channels (devoid of coolant) surrounding each fuel rod. These implosion phenomena are expected to reduce the neutron leakage from the core, causing positive reactivity feedback during the power excursion, and, thereby, affect the final explosion energy for the postulated accident. The results have implications for advanced LMFBR designs since the autocatalytic effects could override the negative Doppler reactivity planned for advanced cores to mitigate the explosion energy of an excursion. (Diss. Abstr. Int., B)

19129 THEORETICAL MODEL FOR THE MOLTEN FUEL-SODIUM INTERACTION IN A NUCLEAR FAST REACTOR. Caldarola, L. (Gesellschaft fuer Kernforschung mbH., Karlsruhe, Ger.). Nucl. Eng. Des.; 22: No. 2, 175-211(1972).

Several theoretical models have been suggested for the description of the processes occurring when molten fuel and coolant interact. However, these models are still at a very unsatisfactory stage. In the model proposed, the reaction has been assumed to occur in two successive phases, which have been called respectively phase A and phase B. In phase A a given mass of molten fuel is suddenly released in small particles, and comes instantaneously in intimate contact with the liquid sodium. The heat transfer process is characterized by a very good thermal contact between the fuel and the coolant, and by a large contact area due to the small size of the particles. The heat transfer coefficient decreases with time due to the formation of a temperature profile inside the fuel particles. The heated volume of sodium is constrained by the surrounding unheated coolant and by the other materials present in the core. The mechanical constraint is schematized by a sodium column of finite length above the reaction volume. The sudden expansion of the heated volume first produces acoustic waves which travel along the sodium column. Later the sodium column behaves as a piston which is pushed inertially upwards. The pressure rises, reaches

a maximum, and then falls as soon as the expansion of the liquid sodium becomes important. At the time at which the pressure reaches the saturation point, sodium boiling starts and phase B begins. The heat transfer process is now characterized by a very large contact area, and by a thermal contact between the fuel and the coolant which becomes increasingly worse with time, due to the formation of a sodium vapor layer at the external surface of the fuel fragments. The sodium will boil in a large quantity, and will produce therefore large volume changes. The sodium piston will be further accelerated and its movement will allow the pressure in the reaction volume to decrease. The exact solution of the heat conduction inside a sphere has been included. The experiments of the heat transfer from a sphere to a boiling liquid are discussed for an evaluation of the thickness of the vapor layer around the sphere. Numerical evaluations for the German S.N.R. fast reactor are also included. (auth)

19130 ANALYSIS OF THE WET-SIDE HEAT-TRANSFER COEFFICIENT DURING REWETTING OF A HOT DRY PATCH. Thompson, T. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Eng. Des.; 22: No. 2, 212-24(1972).

A physical model for the rewetting of a hot dry patch is proposed. The mechanisms governing the rate of resorption of the dry area are the conduction of heat from the dry to the wet area and the removal of this heat by a large local heat-transfer coefficient. The coefficient is assumed to be directly proportional to the cube of the difference between the surface and saturation temperature ($h = RT^3$). The wall temperature at the interface between the wet and dry side is assumed equal to the sputtering value, and the cubic relationship between the heat-transfer coefficient and surface temperature difference is assumed valid up to this temperature. Experimental data from Harwell on rewetting rates for a stainless steel tube in a steam environment at various pressures are analyzed to determine R. The energy equations are solved numerically by a quasi-linearization technique combined with the finite-difference method. (auth)

19131 CONTINUOUS BOILING PHENOMENA OF SODIUM UNDER FORCED CONVECTION BY DIRECT HEATING. Takahashi, Katsuro; Fujii-e, Yoichi; Suita, Tokuo (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 670-9(Nov 1972).

The results of an experimental study on the continuous boiling behavior of sodium with the upward forced convection loop are reported. The sodium was passed through a vertical tube of 14.9 mm ID, where it was heated by dc power (~4V, ~5,000 A) directly applied through the flowing sodium. The experiments were carried out in the following range of conditions: Input power of 6 to 12 kW; Pressure at the condenser of 0.9 to 1.1 kg/cm^2; Flow rate of 1.0 to 3.0l/min; Inlet temperature of 750° to 830°C. Under certain conditions, steady boiling occurred, but boiling generally had a tendency to become unstable, and flow patterns representing violently pulsating boiling were observed. These latter flow patterns were either of single bubble ejection type with expulsion and subsequent refilling of sections of the tube mainly by liquid sodium falling back from above, or else of slug type with periodical expulsions, without fall-back of liquid. For these patterns of pulsating boiling, the frequencies of oscillation ranged from 0.5 to 1.0 Hz. The film thickness remaining on the channel wall was also measured. (auth)

19132 GERMAN RESEARCH PROGRAM FOR REACTOR SAFETY. Atomwirt., Atomtech.; 17: No. 9-10, 494-6(1972). (In German).

On August 9, 1972, the federal minister for education and science submitted a research program for reactor safety which projected an outlay of about 180 million DM during the first five years from 1972 through 1976. A survey of the program is given with explanations as well as with justifications by the federal minister. Budgetary figures are subdivided for basic designs; improvement of safety installations; development of new safety installations; improvement of availability and economy; and studies and analyses. Budgetary figures also are broken down as to industries, universities, and research foundations. (HBG)

Steam and Power Conversion Systems

19133 (BMBW-FBK-72-17) CALCULATION OF CO_2-GAS TURBINE CYCLES (Na/CO_2-PROJECT). Mukherjee, S. K. (Technische Universitaet, Hanover (West Germany). Institut fuer Stroemungsmaschinen). Sep 1972. 108p. (In German). Dep. NTIS (U. S. Sales Only).

Various carbon dioxide cycles for a sodium-cooled fast breeder reactor were investigated. Equations of state were set up, based upon published measurements, and these equations were then applied to the study of the carbon dioxide cycles. Three different types of cycles are proposed. Capital costs and development potentials, with regard to thermal efficiency, are elucidated. The effects of various parameters on the thermal efficiency were also studied for the three cycles proposed. (LTW)

19134 PAROGENERATORNYE USTANOVKI ATOMNYKH ELEKTROSTANTSII. (Steam Generator Installations for Nuclear Electric Stations). Rassokhin, N. G. Moscow; Atomizdat (1972). 384p.

The design and construction of steam generating units for various types of atomic power plants are discussed. The hydrodynamics and heat transfer aspects of steam production are examined. 76 pages of useful data comprise the appendix. 65 references. (KSW).

19135 NET EFFICIENCY OF NUCLEAR/STEAM TURBINE-GAS TURBINE PLANTS. Ratnikov, E. F. (Urals Polytechnic Inst., Sverdlovsk, USSR). Therm. Eng. (USSR) (Engl. Transl.); 18: No. 11, 133-134(Nov 1971).

Translated from Telploenergetika; 18: No. 11, 94(1971).

A previously published analysis of the net efficiency of nuclear steam turbine–gas turbine (STGT) power plants is reviewed. More realistic operating temperatures are substituted for the values chosen for the original analysis and reasons for choosing the new values are explained. The results show that even with assumed turbine and compressor efficiences of 88 to 90% and a lower inlet compressor temperature, the net efficiency of the STGT plant does not exceed 42 to 43% as compared with the previous estimate of 47.8%. A STGT plant with the same initial conditions except that the gas is not cooled before entering the compressor, i.e., without a cooler and a regenerator, should have a net efficiency of 45 to 46% and is considered more economical to construct and operate. (LCL)

Commercial Power Reactors

Refer also to abstract 17250.

19136 (STI/PUB-300(Vol.2)) PEACEFUL USES OF ATOMIC ENERGY. VOLUME 2. Proceedings of the Fourth International Conference, Geneva, 6-16 September 1971. (International Atomic Energy Agency, Vienna (Austria)). Jan 1972. 660p. (CONF-710901-(Vol.2)). IAEA $14.00.

Papers are presented on the performance of nuclear power plants, analysis of power plant costs, and nuclear fuel management aspects. A separate abstract for each paper appeared in NSA Volume 25, Issues 16 and 22. (HDR)

19137 1300 MW NUCLEAR POWER PLANT BIBLIS B WITH SIEMENS PRESSURIZED-WATER REACTOR. Schamburger, R. (Kaftwerk Union AG, Erlangen, Ger.). Atomwirt., Atomtech.; 17: No. 11, 552-5(Nov 1972). (In German).

At the end of August 1971 the contract was signed for construction of the nuclear power plant Biblis B with a gross power of 1300 MW(e). Like the 1200 MW(e) block Biblis A, which is under construction, block Biblis B will have a pressurized-water reactor. With 1300 MW, Biblis B belongs to the largest installations in the world. In April 1972, the first atomic partial licensing was obtained. Electricity production should start in the second half of 1976. The site is described and characteristics of the plant as to power, core, fuel elements, cooling system, control rods, reactor pressure vessel, steam producer, turbines, condensors, generators, and other data are tabulated. (HBG)

19138 LIST OF NUCLEAR POWER PLANTS OF THE WORLD. Kempken, M. Atomwirt., Atomtech.; 17: No. 9-10, 512-17 (1972). (In German).

For the middle of 1972, the power plants in 27 countries are tabulated. Included are those already in operation and those under construction. The list is broken down as to contract letting time; country, identification, and site; owner or operator; reactor type; reactor manufacturer; power in MW(e); start of commercial operation; and total electricity production up to June 30, 1972. (HBG)

Control Elements, Systems, and Instrumentation

19139 (JPRS-56496) TRANSLATIONS ON EASTERN EUROPE. Scientific Affairs No. 257. Translation of articles on Eastern Europe. 29p. NTIS.

The serial report contains articles concerning the development of and progress in the various theoretical and applied scientific disciplines and technical fields; and the administration, structure, personnel, and research plans of leading East European scientific organizations and institutions, particularly the academies of sciences. Separate abstracts have previously been prepared for two of the articles and appear in NSA Vol. 27 under the following abstract numbers: 14065 and 2021. (auth)

19140 TESTING OF THE COMPUTER CONTROL OF THE REACTOR POWER SYSTEM AT THE GENTILLY NUCLEAR POWER STATION. Craik, N. G. (Canatom Ltd., Montreal); Cloutier, P. M.; Duchesne, A. J. J. Brit. Nucl. Energy Soc.; 12: No. 1, 85-94(Jan 1973).

The Gentilly 250 MW(e) boiling light water reactor is completely dependent on computer control. This presented the problem of how to thoroughly test the reactor power control and steam drum level control system, which uses some complex digital computer programs, before the reactor was made critical and raised to power. The successful solution to the problem is described, and involved integrating into the control system on site an analogue simulation of the reactor and steam drums, thus allowing the computer programs and the whole of the control system hardware to be dynamically tested in a closed loop manner. (auth)

Containment Systems, Shielding, Waste Processing, and Radiation Protection

Refer also to abstract 17922.

Cooling Systems

19141 HYDRAULIC ENGINEERING MODEL TESTS FOR THE BASF NUCLEAR POWER PLANT. Deut. Forschungsdienst, Sonderber. Kernenerg.; 16: No. 19, 90-1(1971). (In German).

A description is given of model investigations concerning the flow conditions at the inlet and the outlet, as well as the temperature distribution of the warmed cooling water in the Rhine. (INIS)

19142 COOLING TOWERS FOR NUCLEAR POWER PLANTS. Gerwin, B. Deut. Forschungsdienst, Sonderber. Kernenerg.; 16: No. 22, 104-6(1971). (In German).

A survey is presented of types, operation modes, capital expenditures and influence on electricity prices of cooling towers in Europe and USA. (INIS)

19143 PRESSURE CYCLING TESTS ON SGHWR PRESSURE TUBING. Pickles, B. W.; Johnson, E. R. (United Kingdom Atomic Energy Authority, Risley, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 47-56(Jan 1973).

Tests have been carried out on lengths of tube containing machined partial thickness defects to study defect growth under fatigue conditions. The growth rates of defects have been estimated and found to depend approximately on the test parameters (stress, defect dimensions) and may be described by a simple empirical equation. It has been shown that there is a relationship between growth rate and the stress intensity as estimated by means of linear elastic fracture mechanics. It has been established that under fatigue stress, defects grow through the thickness preferentially. In principle this could lead to failure by leakage, unless the length of the partial thickness defect is greater than the critical defect length for the material, in which case fast fracture could occur. It is shown that for the present coolant conditions of the prototype SGHWR at Winfrith Heath, a defect approximately 5 in. long and with a depth of at least 80% of the wall thickness would be required for a pressure tube to fail by fast fracture during operation. In practice, failure by either leakage or fast fracture is unlikely because there would be insufficient pressure cycles during pressure tube life to give significant growth of the very minor defects which might be present. (auth)

19144 COMPARISON BETWEEN PREDICTED AND MEASURED DYNAMIC STRAIN, INDUCED BY NOISE, IN A NUCLEAR POWER PLANT COMPONENT. Parkin, M. W. (United Kingdom Atomic Energy Authority, Sellafield, Eng.); Stearn, S. M. J. Brit. Nucl. Energy Soc.; 12: No. 1, 77-84(Jan 1973).

Cracks which occurred in the circulator diffusers of the Windscale AGR during operation were considered to be due to acoustically induced fatigue and aggravated by locked-in stress. Using the statistical energy method three predictions have been made, of the response of a Windscale AGR diffuser, in service. These predictions were based on available data, laboratory measurement of the diffuser response and in situ measurements of the diffuser response. The results have been compared with measurements of the diffuser response under full operational conditions, and encouraging agreement has been found. (auth)

Fuel Systems and Components

Refer also to abstract 17955.

19145 (EUR-4909) POST-IRRADIATION ANALYSIS OF TRINO VERCELLESE REACTOR FUEL ELEMENTS. Bresesti, A. M.; Bresesti, M.; Facchetti, S.; (and others) (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center; European Atomic Energy Community, Karlsruhe (West Germany). European Transuranium Inst.). Dec 1972. 108p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 150.-.

Under the joint EURATOM-ENEL research program for the development of water reactor technology, post-irradiation analyses were carried out on three fuel assemblies irradiated at 8,000 to 14,000 MWd/t (U) in the TRINO VERCELLESE pressurized water reactor. Visual and photographic examinations of selected fuel rods and metallography of fuel and canning materials showed a very good irradiation behavior of the fuel elements. The main objective of the program was the determination of burnup and isotopic composition of selected fuel samples in order to evaluate the accuracy of the calculation methods developed by FIAT NUCLEARE. Radioactive fission products have been measured by gamma spectrometry. The fission product ^{148}Nd and the uranium and plutonium nuclides have been determined by mass spectrometry combined with isotopic dilution techniques. The experimental data obtained for burn-up and for the concentrations of uranium and plutonium nuclides have been compared with theoretical predictions obtained by means of computer codes. (auth)

19146 OPERATIONAL BEHAVIOR OF THE CLADDING OF BUGEY FUEL ELEMENT. Millet, P. (CEN de Saclay, Gif-sur-Yvette, France). pp 167-77 of Choice of Metallic Materials. Paris; Masson (1972). (In French).

From 13th conference on metallurgy; Saclay, France (25 Jun 1970). See CONF-700672.

An annular fuel element was developed for Bugey I. A metallurgical bonding between the cladding and the fuel element was studied. Al is used as the bonding metal. A diffusion treatment was carried out after a schoop process with aluminum powder and uranium. Irradiation tests performed either on samples or on schooped fuel rods demonstrated that the bonding resistance and the Pu antidiffusion barrier were sufficient. This bonding leads to an embrittlement of the cladding: Al diffuses into the cladding material and precipitates Zr in the form of $ZrAl_2$ compounds. Diffusion and tensile creep experiments indicate the probability of a leak produced by the joining of cavities is very small. (FR)

Operation and Economics

19147 (AEC-tr-7413) GUNDREMMINGEN (KRB) NUCLEAR POWER STATION ANNUAL REPORT, 1971. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). Translation of a German report. 51p. Dep. NTIS.

The operation and maintenance of the Gundremmingen (KRB) power reactor in 1971 is described. (JWR)

19148 (AECL-4273) ESTIMATING CANDU FUEL COSTS. Segel, A. W. L. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1972. 20p. (CONF-720966-1). Dep. NTIS (U. S. Sales Only). AECL $0.50.

From IAEA study group meeting on the facilities and technology needed for nuclear fuel manufacture; Grenoble, France (Sep 1972).

A method of estimating CANDU fuel costs is described. The equations are sufficiently generalized that the method can be applied to a new fabrication industry where the fabrication techniques, costs of buildings, equipment and labor, and financial practices differ from those in Canada. Once a reference design cost has been established, the method can be used to estimate the effect on fuel cost due to expansion of the industry, learning and design modifications. When applied to Canadian industry the method estimates the known fuel costs with adequate accuracy. It is also apparent that the low cost for CANDU fuel is due largely to the simple design and small number of components. Even when enriched, the cost of CANDU fuel is significantly lower than the cost of light-water reactor fuel. (auth)

19149 (DOCKET-50003-153) INDIAN POINT STATION, UNIT 1. Technical Specifications, Change 49. (Directorate of Licensing (AEC), Washington, D. C.). 12 Jan 1973. 2p. Dep. NTIS

Revised technical specifications are presented concerning maintenance on control rod drive mechanisms while containment doors are open. (DCC)

19150 (DOCKET-50010-130) DRESDEN NUCLEAR POWER STATION, UNIT 1. Inservice Inspection Program. (Commonwealth Edison Co., Chicago, Ill.). 25 Jan 1973. 17p. Dep. NTIS.

19151 (DOCKET-50016-179) ENRICO FERMI ATOMIC POWER PLANT, REPORT FOR OCTOBER 1972. (Power Reactor Development Co., Detroit, Mich). 1972. 11p. (PRDC-EF-110). Dep. NTIS.

19152 (DOCKET-50237-296) DRESDEN NUCLEAR POWER STATION, UNIT 2. Technical Specifications, Change 19. (Commonwealth Edison Co., Chicago, Ill.). 8 Jan 1973. 10p. Dep. NTIS.

Revised technical specifications are presented concerning in-service inspection requirements for furnace sensitized stainless steel components. (DCC)

19153 (DOCKET-50245-184) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Action Taken to Correct Items of Violation of AEC Requirements Following Inspection of October 20–21; 26–28; October 30; November 2; 6–7, 1972. (Millstone Point Co., Hartford, Conn.). 20 Dec 1972. 30p. Dep. NTIS.

Additional information is presented concerning quality assurance requirements for operation and inspection of cooling system valves for chloride contamination. (DCC)

19154 (DOCKET-50255-131) PALISADES PLANT. Monthly Primary and Secondary Radioactivity and Effluent Report, December 1972. (Consumers Power Co., Jackson, Mich). 26 Jan 1973. 2p. Dep. NTIS.

19155 (DOCKET-50255-132) PALISADES PLANT. Steam Generator Tube Leak on January 15, 1973. (Consumers Power Co., Jackson, Mich.). 29 Jan 1973. 2p. Dep. NTIS.

19156 (DOCKET-50259-74) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, and 3. Environmental Radioactivity Levels, Semiannual Report, January–June 1972. (Tennessee Valley Authority, Chattanooga. Div. of Environmental Research and Development). 26 Jan 1973. 34p. (DOCKET-50260-70; DOCKET-50296-68). Dep. NTIS.

19157 (DOCKET-50261-138) H. B. ROBINSON UNIT 2. Technical Specifications, Change 11. (Carolina Power and Light Co., Raleigh, N. C.). 9 Jan 1973. 4p. Dep. NTIS.

Revised technical specifications are presented concerning a reduction in quadrant power tilt limits. (DCC)

19158 (DOCKET-50261-139) H. B. ROBINSON UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels. (Carolina Power and Light Co., Raleigh, N. C.). 23 Jan 1973. 2p. Dep. NTIS.

19159 (DOCKET-50266-98) POINT BEACH NUCLEAR PLANT, UNIT 1. Personnel Overexposure. (Wisconsin Electric Power Co., Milwaukee). 18 Dec. 1972. 29p. Dep. NTIS.

19160 (DOCKET-50271-138) VERMONT YANKEE NUCLEAR POWER STATION. Final Safety Analysis Report, Proposed Change 7. (Vermont Yankee Nuclear Power Corp., Rutland). 23 Jan 1973. 6p. Dep. NTIS.

Modifications to the off gas system piping and valve arrangements are described. (DCC)

19161 (DOCKET-50280-102) SURRY POWER STATION, UNITS 1 AND 2. Simultaneous Actuation of a Safety Injection Signal on Both Units of a Dual Unit Facility. (Virginia Electric and Power Co., Richmond). 27 Oct 1972. 6p. (DOCKET-50281-82). Dep. NTIS.

19162 (DOCKET-50280-104) SURRY POWER STATION, UNITS 1 AND 2. Technical Specifications, Change 4. (Directorate of Licensing (AEC), Washington, D. C.). 17 Jan 1973. 7p. (DOCKET-50281-85). Dep. NTIS.

Revised technical specifications are presented concerning heatup and cooldown limits and flushing frequency for sensitized pipes. (DCC)

19163 (DOCKET-50409-32) LA CROSSE BOILING WATER REACTOR. Seal Injection System, Differential Pressure Transmitter Failed. (Dairyland Power Cooperative, La Crosse, Wis.). 5 Jan 1973. 4p. (DPC-72-17).

19164 (DOCKET-50409-33) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for October 1972. (Dairyland Power Cooperative, La Crosse, Wis). 1972. AT(11-1)-851. 34p. (DPC-851-49). Dep. NTIS.

19165 (EUR-4912) GUNDREMMINGEN (KRB) NUCLEAR POWER PLANT. ANNUAL REPORT, 1971. (Kernkraftwerk RWE-Bayernwerk G.M.B.H., Gundremmingen (West Germany)). Dec 1972. 70p. (In German). Dep. NTIS (U. S. Sales Only). EUR BF 100.-.

The power plant was in continuous operation at full capacity throughout 1971. The summer inspection took only five weeks and during this period, with availability reduced to 90.2%, production still amounted to 1991 GWh. Apart from brief load adjustments spread over the whole year for control rod changes, routine tests and training of personnel, there was one automatic shutdown when the plant was struck by lightning. The plant also had to be shut down briefly on two occasions for repairs to leaks in the turbine condenser and the extraction steam pipes. The leaks in the extraction steam pipes were the result of erosion due to water entrained in the steam. Such leaks will be reduced in the future by the use of stronger materials and by means of design improvements. The condenser pipe leaks were found to be a delayed after-effect of the turbine blade damage dating back to 1968. The important operations carried out during the shutdown period (12 June–17 July 1971) included the following: refuelling; inspection of HP and LP sections of turbine; inspection of reactor pressure vessel; dismantling and inspection of 10 control rod drives; and large-scale testing of all protection and safety systems. In addition to the KRB's regular staff of 110, 177 outside employees were taken on during the shutdown period and monitored. A total of 240 rem was recorded for all the staff monitored during this period. After restart of the plant the values for the specific activity of the primary water and the gaseous activity were about two-thirds down on the pre-inspection readings and remained constant until the end of the year. Work continued on the off-site shipment of irradiated fuel assemblies for reprocessing at Mol and, in addition, 240 casks containing low-activity waste were sent to Asse for trial storage. (auth)

19166 (EUR-4923) LATINA NUCLEAR POWER PLANT. ANNUAL REPORT 1971. (Ente Nazionale per l'Energia Elettrica, Latina (Italy)). Feb 1973. 54p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR FB 70.-.

During the report period the plant operated with an utilization factor of 60.31% and an availability of 67.18%, these figures being calculated on the basis of a gross electric output of 160 MW. The reduction in the gas outlet temperature, which was decided on in order to control the oxidation of the steels in the presence of carbon dioxide, led to a drop of about 25% in the rated output (from 210 to 160 MW). The main reasons for the outage of the plant were the scheduled shutdown for general maintenance and the fact that turbo-alternators 1 and 5 were out of commission until the end of October and December respectively, with an average loss of about 40 MW. The difference between availability and utilization is due mainly to the shutdowns of the plant as a result of strike action. 32.82% of the total plant non-availability was due to the conventional part, 3.41% to the nuclear part and the remaining 18.01% to other causes. (auth)

19167 (STI-PUB-300(Vol.4)) PEACEFUL USES OF ATOMIC ENERGY. VOLUME 4. PROCEEDINGS SERIES. PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE HELD IN GENEVA, SWITZERLAND, SEPTEMBER 6–16, 1971. (International Atomic Energy Agency, Vienna (Austria)). Mar 1972. 517p. (In several languages). (CONF-710901-Vol.4). IAEA $14.00.

From 4th International Conference on the Peaceful Uses of Atomic Energy; Geneva, Switzerland (6 Sep 1971).

Papers are presented on integration of nuclear power plants in electrical networks, planning to meet nuclear fuel cycle requirements, and developments in fuel materials technology. A separate abstract for each paper was included in NSA Volume 25, Issues 16 and 22. (HDR)

19168 BEZNAU II NUCLEAR POWER PLANT: PROJECT IMPLEMENTATION AND PLANT START-UP. Thee, W. B. (Westinghouse Electric Nuclear Energy Systems Europe, Brussels). Ind. At. Spatiales; 16: No. 4, 15-19(Jul 1972). (In French and English).

The conditions under which Beznau II was constructed are reviewed: projects organization, engineering coordination, project planning, procurement, and subcontracting. The different tests carried out during the start-up program are discussed; hot and cold hydrostatic tests following repairs to the cladding of the steam generators; zero-power testing; increasing of the power; semi-industrial testing. (France)

19169 VINTER COMMITTEE AND THE BRITISH NUCLEAR INDUSTRY. Rippon, S. E. Rev. Fr. Energ.; 23: No. 244, 463-6(Jul 1972). (In French).

The Vinter committee has been given the task of studying the nuclear reactor policy to be pursued in Great Britain. The findings of this committee will not be made public. The initial difficulties encountered by the British Nuclear Industry are discussed together with the problems facing the industry concerning the choice of a thermal reactor and the introduction of breeder reactors. No decision has been taken. (FR)

19170 SGHWR FUEL MANAGEMENT. Manning, G. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Brit. Nucl. Energy Soc.; 12: No. 1, 129 (Jan 1973).

Modifications to the proposed SGHWR fuel management scheme are suggested. From a study of several alternative schemes by

calculation with EQUICORE, it is concluded that instead of a nine-cycle dual feed enrichment scheme without shuffling, a very limited amount of shuffling can be used to obtain an increase of power output of at least 7%, with neither loss of burn-up nor a significant increase in shut-down time. (UK)

19171 OPTIMAL IN-CORE FUEL MANAGEMENT FOR PWRs. Chitkara, K. K. Cincinnati; Univ. of Cincinnati (1972). 296p. University Microfilms Order No. 73 581.

Thesis (Ph. D.).

Current PWR in-core fuel management practice optimizes the initial refueling cycles and then sets plant power at the level attainable in these initial cycles. Since equilibrium conditions are closely approached in only three or four cycles, equilibrium power costs dominate plant economics. Therefore, an approach which minimizes the power cost under equilibrium conditions can lead to near optimum costs over the life of the plant. The optimal equilibrium design information may then be used to set the refueling pattern for the earlier cycles including the initial core design. The problem of optimal equilibrium fuel loading was formulated from a designer's standpoint. The core was treated on an assembly-by-assembly basis in order to determine the detailed fuel loading policies. A simplified model for predicting core behavior based upon a modified one-group diffusion theory and using a matrix technique for its solution was developed. Equilibrium conditions were synthesized by an iterative approach. This model was very rapid but not highly accurate. A combination of the assignment algorithm and direct search was used as the optimization techniques for determination of the reloading pattern. The objective was the minimization of the equilibrium power cost subject to power peaking, discharge burnup, and reactivity constraints. The San Onofre nuclear reactor was chosen as the reference reactor upon which the utility of this approach would be demonstrated. By assuming a quarter core symmetry, the fuel loading policies within $\frac{1}{4}$ core were determined. The reloading pattern optimization was coupled with a search over the number of fuel assemblies added to the core. The lowest cost solution corresponded to adding 13 fresh assemblies with a feed enrichment of 4.00 w/o to the $\frac{1}{4}$ core. For the initial core optimization, the core was divided into three regions (inverse of the optimal batch size from the equilibrium study). A search program and the simplified model were used to determine the optimal zonal enrichments (3.10, 3.50, and 3.85 w/o) resulting in the minimal radial peak-to-average power ratio while meeting the necessary reactivity constraint at E.O.L. By use of the optimal equilibrium refueling policy, the other pre-equilibrium cycle information was calculated. The equilibrium power costs obtained within this study were lower than those based upon current practice by approximately 5%. Only in the case of the second cycle, did the present approach give a higher cost (by nearly 4%) than current practice. Therefore, it appears that the present approach of first optimizing equilibrium core management and then using the equilibrium information for pre-equilibrium refueling patterns should result in an appreciable overall economic savings. (Diss. Abstr. Int., B)

19172 GOVERNMENT SPENDING FOR NUCLEAR ENERGY IN WEST GERMANY FOR 1970 TO 1972. Atomwirt., Atomtech.: 17: No. 9-10, 497-8(1972). (In German).

As published by the federal ministry for education and science, both federal and state budgets project approximately 1.6 billion DM for the support of research, development, and utilization of nuclear energy in 1972. This corresponds nearly with the expenses for 1971. The federal budget is slightly lower than that of previous years; however, it contains no provisions for fuel supply from foreign countries and for the society for radiation and environmental research. The state budgets are increased about 3% above the previous year. From 1956 through 1972, a total of 11.9 billion DM was spent for nuclear energy. Of this amount, 9.4 billion DM were carried by the federal government while 2.6 billion DM were contributed by the states. In four tables, expenses of federal and state governments are compiled and detailed as to their purposes. (HBG)

19173 EXPERIENCE WITH CONSTRUCTION AND OPERATION OF LIGHT WATER REACTORS IN THE BRD. Weckesser, A. (Kernkraftwerk RWE-Bayernwerk GmbH., Gundremmingen, Ger.); Keller, W.; Kornbichler, H. Atomwirt., Atomtech.: 17: No. 9-10, 479-83(1972). (In German).

Three demonstration nuclear power plants, KRB, KWO, and KWL, proved exceedingly useful. The installations contributed significantly to further development of nuclear techniques. During the time of operation, no person was injured either inside or outside of the plants. Occasional disturbances of operation were encountered. In these cases, no incidents occurred which exceeded, or even reached the available installed safety provisions. Activity release showed that the designers as well as the operators could suppress environmental effects to such a degree that it was impossible to measure and was far below the requirements established by the government. (tr-auth)

Safety and Siting

Refer also to abstracts 17255, 17594, 17600–17602, and 17946.

19174 (AEC-tr-7358) INSTITUTE FOR REACTOR SAFETY: 1971 BUSINESS REPORT. ([Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit]). Translation of a German report. 104p. Dep. NTIS.

Safety aspects of nuclear power plants in West Germany are discussed. (JWR)

19175 (BNWL-1361) METAL-WATER REACTIONS OF IRRADIATED N-REACTOR FUELS AT 1025 TO 1080°C. Reid, D. L.; Hesson, G. M.; Hammond, J. E. (Battelle Pacific Northwest Labs., Richland, Wash.). Aug 1970. Contract AT(45-1)-1830. 43p. Dep. NTIS.

For Douglas United Nuclear, Inc., Richland, Wash.

Declassified 15 Mar 1972.

The first experimental data obtained on the metal-water reaction of massive, irradiated, Zircaloy-2 clad uranium tubular fuels at temperatures between cladding rupture and the uranium melting point are reported. Analyses of the data showed that physical changes produced an apparent reaction rate law other than parabolic and the reaction rate constant and translocation of uranium were inversely related to irradiation level for the range investigated. All data correlated to within ±10% with the function $Q = A\,t^{0.72}$ where Q is the volume of hydrogen, t is time after cladding rupture in minutes and A is the rate constant related to the effective surface area. Photographs of the typical physical changes in the fuel are included. An equation was developed for reactor application. (4 references) (auth)

19176 (DOCKET-50206-181) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical specifications, proposed change No. 11. (Southern California Edison Co., Rosemead, Calif.). 19 Jan 1973. 6p. Dep. NTIS.

Revised technical specifications are presented concerning monitoring requirements for liquid radioactive effluents. (DCC)

19177 (DOCKET-50213-175) HADDAM NECK PLANT, UNIT 1. Limitorque Valve Operators. (Connecticut Yankee Atomic Power Co., Hartford). 22 Dec 1972. 3p. Dep. NTIS.

19178 (DOCKET-50219-232) OYSTER CREEK NUCLEAR POWER PLANT, Unit 1. Limitorque Valve Operators. (Jersey Central Power and Light Co., Morristown, N. J.). 4 Jan 1973. 3p. Dep. NTIS.

19179 (DOCKET-50220-123) NINE MILE POINT NUCLEAR STATION, UNIT 1. Limitorque Valve Operators. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 19 Dec 1972. 3p. Dep. NTIS.

19180 (DOCKET-50237-295) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Special Report 19. Quad-Cities Station, Units 1 and 2. Special Report 6. Feedwater Control System Modifications. (Commonwealth Edison Co., Chicago, Ill.). 24 Jan 1973. 8p. (DOCKET-50249-185; DOCKET-50254-159; DOCKET-50265-151). Dep. NTIS.

19181 (DOCKET-50244-137) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Limitorque Valve Operators. (Rochester Gas and Electric Corp., N. Y.). 18 Dec 1972. 3p. Dep. NTIS.

19182 (DOCKET-50244-138) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Valve Wall Thickness. (Rochester Gas and Electric Corp., N. Y.). 1 Nov 1972. 10p. Dep. NTIS.

19183 (DOCKET-50245-187) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Limitorque Valve Operators. (Millstone Point Co., Hartford, Conn.). 22 Dec 1972. 3p. Dep. NTIS.

19184 (DOCKET-50249-187) DRESDEN NUCLEAR POWER STATION, UNIT 3. Facility operating license DPR-25, Amendment 2. (Commonwealth Edison Co., Chicago, Ill.). 26 Jan 1973. 3p. Dep. NTIS.

19185 (DOCKET-50263-178) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Limitorque Valve Operators. (Northern States Power Co., Minneapolis, Minn.). 19 Jan 1973. 2p. Dep. NTIS.

19186 (DOCKET-50269-87) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Revision 26. (Duke Power Co., Charlotte, N. C.). 29 Jan 1973. 263p. (Docket-50270-72; Docket-50287-64). Dep. NTIS.

Revised and requested data are presented concerning the site, personnel, auxiliary systems, liquid radioactive effluents, buildings, flooding of engineered safeguards, and coolant loss accident analysis. (DCC)

19187 (DOCKET-50277-74) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Limitorque Valve Operators. (Philadelphia Electric Co., Pa.). 29 Dec 1972. 4p. (DOCKET-50278-72). Dep. NTIS.

19188 (DOCKET-50277-75) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report, Proposed Technical Specifications, Appendix B, February 1973. (Philadelphia Electric Co., Pa.). 9 Feb 1973. 276p. (DOCKET-50278-73). Dep. NTIS.

19189 (DOCKET-50298-62) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 16. (Nebraska Public Power District, Columbus). 5 Jan 1973. 15p. Dep. NTIS.

Requested information is presented concerning the reactor site, structures, fuel elements, containment structure, electrical system, and auxiliary systems. (DCC)

19190 (DOCKET-50298-63) COOPER NUCLEAR STATION. Order extending completion date to December 1, 1973. (Nebraska Power District, Columbus). 30 Jan 1973. 3p. Dep. NTIS.

19191 (DOCKET-50305-65) KEWAUNEE NUCLEAR POWER PLANT. Preoperational Radiological Monitoring Program, Second Annual Report, September 1970-August 1971. (Industrial Bio-Test Labs., Inc., Northbrook, Ill). 25 Jan 1972. 96p. Dep. NTIS.

19192 (DOCKET-50313-62) ARKANSAS NUCLEAR ONE, UNIT 1. Environmental Report, Supplement 5. (Arkansas Power and Light Co., Little Rock). 19 Jan 1973. 69p. Dep. NTIS.

19193 (DOCKET-50315-94) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Application for License, Amendment 29. (Indiana and Michigan Power Co., New York). Jan 1973. 8p. (Docket-50316-94). Dep. NTIS.

Additional financial data on the owners of the Donald C. Cook Power Reactor Units 1 and 2 are presented. (DCC)

19194 (DOCKET-50322-32) SHOREHAM NUCLEAR POWER STATION, UNIT 1. Fuel densification effect. (Long Island Lighting Co., Hicksville, N. Y.). 3 Jan 1973. 2p. Dep. NTIS.

19195 (DOCKET-50329-34) MIDLAND PLANT, UNITS 1 AND 2. Final Environmental Statement. (Division of Radiological and Environmental Protection (AEC), Washington, D. C.). Mar 1972. 379p. (DOCKET-50330-33). Dep. NTIS.

The environmental effects of construction and operation of the Midland Power Reactor Units 1 and 2 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (DCC)

19196 (DOCKET-50331-73) DUANE ARNOLD ENERGY CENTER. UNAUTHORIZED HEATING AND BENDING OF PIPE. Use of Incorrect Weld Filler Material. Oversize Incore Housing Bores. (Iowa Electric Light and Power Co., Cedar Rapids). 11 Jan 1973. 10p. Dep. NTIS.

19197 (DOCKET-50331-74) DUANE ARNOLD ENERGY CENTER. Final safety analysis report, Amendment 11. (Iowa Electric Light and Power Co., Cedar Rapids). 8 Jan 1973. 176p. Dep. NTIS.

Requested information is presented concerning the performance of main steam isolation valves following a coolant loss accident. (DCC)

19198 (DOCKET-50331-75) DUANE ARNOLD ENERGY CENTER. Use of Incorrect Weld Filler Material. (Iowa Electric Light and Power Co., Cedar Rapids). 11 Jan 1973. 4p. Dep. NTIS.

19199 (DOCKET-50331-79) DUANE ARNOLD ENERGY CENTER. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 23 Jan 1973. 207p. Dep. NTIS.

19200 (DOCKET-50331-80) DUANE ARNOLD ENERGY CENTER. Fuel densification effects. (Iowa Electric Light and Power Co., Cedar Rapids). 29 Dec 1972. 2p. Dep. NTIS.

19201 (DOCKET-50333-75) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Application for licenses, Amendment 19. (Power Authority of the State of New York). 10 Jan 1973. 7p. Dep. NTIS.

19202 (DOCKET-50333-76) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report, Supplement 19. (Power Authority of the State of New York). 8 Jan 1973. 63p. Dep. NTIS.

Revised and requested data are presented concerning the containment atmosphere dilution system. (DCC)

19203 (DOCKET-50333-77) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Action Taken to Correct Item of Violation Brought to Attention Following Inspection of October 25-27, 1972. (Power Authority of the State of New York). 27 Dec 1972. 18p. Dep. NTIS.

Information is presented concerning the quality assurance requirements for electric motor storage. (DCC)

19204 (DOCKET-50333-78) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Containment Atmosphere Dilution. (Power Authority of the State of New York). 22 Jan 1973. 4p. Dep. NTIS.

19205 (DOCKET-50333-79) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Safety evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 1 Feb 1973. 24p. Dep. NTIS.

19206 (DOCKET-50335-39) ST. LUCIE PLANT, UNIT 1. Flooding of Safety Related Equipment During Construction, Interim Report. (Florida Power and Light Co.). 11 Jan 1973. 17p. Dep. NTIS.

19207 (DOCKET-50335-41) ST. LUCIE PLANT, UNIT 1. Pump Room Flooding. (Florida Power and Light Co.). Dec 1972. 16p. Dep. NTIS.

19208 (DOCKET-50344-37) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, General Information, Application for License. (Portland General Electric Co., Oreg.). 5 Feb 1973. 170p. Dep. NTIS.

Application for an operating license for the Trojan Power Reactor Unit 1 is presented. Financial data on the owners of the reactor are included. (DCC)

19209 (DOCKET-50344-38) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Volume 1. (Portland General Electric Co., OREG). 5 Feb 1973. 652p. Dep. NTIS.

Information on the Trojan Power Reactor Unit 1 is presented concerning site characteristics and building floor plans. (DCC)

19210 (DOCKET-50344-39) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Volume 2. (Portland General Electric Co., OREG). 5 Feb 1973. 307p. Dep. NTIS.

Information on the Trojan Power Reactor Unit 1 is presented concerning design criteria for structures, components, equipment, and systems. (DCC)

19211 (DOCKET-50344-40) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Volume 3. (Portland General Electric Co., OREG). 5 Feb 1973. 525p. Dep. NTIS.

Information on the Trojan Power Reactor Unit 1 is presented concerning the containment structure, buildings, structures, and electrical equipment. (DCC)

19212 (DOCKET-50344-41) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Volume 4. (Portland General Electric Co., OREG). 5 Feb 1973. 562p. Dep. NTIS.

Information on the Trojan Power Reactor Unit 1 is presented concerning general design characteristics and the cooling system. (DCC)

19213 (DOCKET-50344-42) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Volume 5. (Portland General Electric Co., OREG). 5 Feb 1973. 609p. Dep. NTIS.

Information on the Trojan Power Reactor Unit 1 is presented under the following main headings: engineered safeguards; instrumentation; and control systems. (DCC)

19214 (DOCKET-50344-44) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Volume 7. (Portland General Electric Co., OREG). 5 Feb 1973. 572p. Dep. NTIS.

Information on the Trojan Power Reactor Unit 1 is presented under the following main headings: power conversion system; radioactive waste management; and radiation protection. (DCC)

19215 (DOCKET-50344-45) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Volume 8. (Portland General Electric Co., OREG). 5 Feb 1973. 877p. Dep. NTIS.

Information on the Trojan Power Reactor Unit 1 is presented under the following main headings: operations aspects; initial tests; and accident analysis. (DCC)

19216 (DOCKET-50344-46) TROJAN NUCLEAR PLANT. Final Safety Analysis Report, Volume 9. (Portland General Electric Co., OREG). 5 Feb 1973. 502p. Dep. NTIS.

Information on the Trojan Power Reactor Unit 1 is presented under the following main headings: technical specifications; and quality assurance program. (DCC)

19217 (DOCKET-50348-50) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jun 1972. 260p. (Docket-50364-42). Dep. NTIS.

The environmental effects of construction and operation of the Joseph M. Farley Power Reactor Units 1 and 2 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits–cost analysis of the proposed plant operation. (DCC)

19218 (DOCKET-50358-43) WILLIAM H. ZIMMER NUCLEAR POWER STATION, UNIT 1. Fuel Densification Effects. (Cincinnati Gas and Electric Co., Ohio). 2 Jan 1973. 1p. Dep. NTIS.

19219 (DOCKET-50361-35) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Fuel Densification Effects. (Southern California Edison Co., Rosemead, Calif). 4 Jan 1973. 7p. (DOCKET-50362-34). Dep. NTIS.

19220 (DOCKET-50363-44) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Arkansas nuclear one-unit 2 parametric study of ECCS applicable. (Jersey Central Power and Light Co., Morristown, N. J.). 15 Jan 1973. 2p. Dep. NTIS.

19221 (DOCKET-50367-33) BAILLY GENERATING STATION, NUCLEAR I. Fuel densification effects. (Northern Indiana Public Service Co., Hammond). 5 Jan 1973. 1p. Dep. NTIS.

19222 (DOCKET-50390-33) WATTS BAR NUCLEAR PLANT, UNITS 1 and 2. Construction Permit CPPR-91 and CPPR-92. (Directorate of Licensing (AEC), Washington, D. C.). 23 Jan 1973. 50p. (Docket-50391-33). Dep. NTIS.

19223 (DOCKET-50390-34) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 20. (Tennessee Valley Authority, Chattanooga). 19 Jan 1973. 48p. (DOCKET-50391-34).

Revised and additional data are presented concerning the quality assurance program for construction. (DCC)

19224 (DOCKET-50395-36) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Jan 1973. 302p. Dep. NTIS.

The environmental effects of construction and operation of the Virgil C. Summer Power Reactor Unit 1 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits–cost analysis of the proposed plant operation. (DCC)

19225 (DOCKET-50395-38) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 12 Jan 1973. 169p. Dep. NTIS.

19226 (DOCKET-50395-39) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 20. (South Carolina Electric and Gas Co., Columbia). 22 Jan 1973. 53p. Dep. NTIS.

Additional data are presented concerning the service water pond earth dams. (DCC)

19227 (DOCKET-50397-37) HANFORD NO. 2 NUCLEAR POWER PLANT. Safety evaluation, Supplement 2. (Directorate of Licensing (AEC), Washington, D. C.). 12 Jan 1973. 22p. NTIS.

19228 (DOCKET-50398-31) MENDOCINO POWER PLANT, UNITS 1 AND 2. Application withdrawal requested. (Pacific Gas and Electric Co., San Francisco, Calif.). 19 Jan 1973. 2p. (DOCKET-50399-31). Dep. NTIS.

19229 (DOCKET-50404-35) NORTH ANNA POWER STATION, UNITS 3 AND 4. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 29 Dec 1972. 170p. (DOCKET-50405-35). Dep. NTIS.

19230 (DOCKET-50410-20) NINE MILE POINT NUCLEAR STATION, UNIT 2. Environmental Report, Supplement 4. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 8 Jan 1973. 141p. Dep. NTIS.

19231 (DOCKET-50423-1) MILLSTONE NUCLEAR POWER STATION, UNIT 3. License Application. (Millstone Point Co., Hartford, Conn). 7 Feb 1972. 65p. Dep. NTIS.

19232 (DOCKET-50423-3) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, Volume 1. (Millstone Point Co., Hartford, Conn.). Feb 1973. 412p. Dep. NTIS.

Information on the Millstone Point Power Reactor Unit 3 is presented concerning physics calculations and the reactor site characteristics. (DCC)

19233 (DOCKET-50423-4) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, Volume 2. (Millstone Point Co., Hartford, Conn.). Feb 1973. 323p. Dep. NTIS.

Information on the Millstone Point Power Reactor Unit 3 is presented concerning the reactor site and reactor structures and equipment. (DCC)

19234 (DOCKET-50423-5) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, Volume 3. (Millstone Point Co., Hartford, Conn.). 7 Feb 1973. 330p. Dep. NTIS.

Information on the Millstone Point Power Reactor Unit 3 is presented under the following main headings: cooling system; engineered safeguards; instrumentation; control system; and electrical system. (DCC)

19235 (DOCKET-50423-6) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, Volume 4. (Millstone Point Co., Hartford, Conn.). 7 Feb 1973. 437p. Dep. NTIS.

Information on the Millstone Point Power Reactor Unit 3 is presented under the following main headings: auxiliary systems; steam and power conversion system; and radioactive waste management. (DCC)

19236 (DOCKET-50423-7) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, Volume 5. (Millstone Point Co., Hartford, Conn.). 7 Feb 1973. 339p. Dep. NTIS.

Information on the Millstone Point Power Reactor Unit 3 is presented under the following main headings: radiation protection; operations; initial tests; accident analysis; technical specifications; and quality assurance program. (DCC)

19237 (DOCKET-50423-8) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, Addendum 1. (Millstone Point Co., Hartford, Conn.). 7 Feb 1973. 306p. Dep. NTIS.

Additional information is presented concerning the reactor site, engineered safeguards, fuel storage facilities, emergency systems, radioactive effluents, and personnel. (DCC)

19238 (FIND-50404(1-73)) FIND: NORTH ANNA POWER STATION UNITS 3 AND 4. Gamble, R. L. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 12 Jan 1973. 24p. (FIND-50405(1-73)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (JWR)

19239 (STI-PUB-300(Vol.3)) PEACEFUL USES OF ATOMIC ENERGY. VOLUME 3. PROCEEDINGS SERIES. PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE HELD AT GENEVA, SWITZERLAND, SEPTEMBER 6-16, 1971. (International Atomic Energy Agency, Vienna (Austria)). Dec. 1971. 487p. (In several languages). (CONF-710901-Vol.3). IAEA $14.00.

From 4th International Conference on the Peaceful Uses of Atomic Energy; Geneva, Switzerland (6 Sept 1971).

Papers are presented on the safety aspects of nuclear power plants and on legal aspects of nuclear energy. A separate abstract for each paper appeared in NSA Volume 25, Issues 16 and 22. (HDR)

19240 NEW BRUNSWICK PLANS FOR A NUCLEAR PLANT. Mod. Power Eng.: 66: No. 8, 54-5(Aug 1972).

New Brunswick Electric Power Commission is discussing a possible nuclear power station with Atomic Energy of Canada Ltd., and with the federal government. The unit would have 0.5 to 0.6 GW capacity, and cost up to $600 million. It would be associated with the 2 GW fossil-fueled station being built at Lorneville. Probably the entire output of the nuclear station would be exported to New England, with provision for its retention if required. Also discussed are the high-voltage dc terminal at Eel River, and additional hydroelectric plant at Mactaquac. (CA)

19241 BACKGROUND REPORT ON POWERPLANT SITING. FOR THE USE OF THE COMMITTEE ON COMMERCE, UNITED STATES SENATE, NINETY SECOND CONGRESS, SECOND SESSION, JULY 1972. Washington, D. C.: Joint Committee on Atomic Energy (1972). 80p. GPO.

Information is presented for use by the Committee on Commerce of the US Senate in proposing and evaluating legislation related to power plant siting. Background information is provided on the growth of electric power consumption in the US and the environmental effects of electric power industry operations, namely air and water pollution, radiation hazards, and landscape impacts. Federal, state, and local regulation of power plant siting is reviewed. Summaries are presented of the April to July 1972 hearings before the Committee on proposed power plant siting legislation. Two appendixes are included on selected hearings and legal commentary on power plant siting and on three specific Senate bills related to power plant siting. (LCL)

19242 PROTECTION OF WORKERS AGAINST RADIATION DURING THE RESTARTING OF THE SAINT-LAURENT-DES-EAUX NUCLEAR POWER STATION. Beau, P.; Hurtiger, J.; Grand, J. (Electricite de France, Saint-Laurent-des-Eaux). pp 245-61 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

After six months of satisfactory operation, the accident of October 17, 1969 brought the St. Laurent des Eaux Nuclear Power Station (first stage) to a sudden standstill. As the result of an error in the programming of the loading machine, five of the fifteen elements of a channel melted and uranium debris was scattered in the vessel. The repairs consisted of recovering the debris either remotely, or by direct access from the core and installing a complete carbon dioxide filtering system beneath the heat exchangers. The risks to which the workers were exposed are discussed (temperature, uranium toxicity, irradiation contamination, fire hazards); the organization of the different working operations in the various parts of the reactor vessel is outlined. The training of the working personnel is discussed and the equipment used is described. (France)

19243 NUCLEAR POWER PLANTS AND THEIR STRUCTURAL DESIGN FOR DYNAMIC LOADS. Klein, G. (Kraftwerk Union AG, Frankfurt am Main). Konstr. Ing. Ber.; No. 10, 79-86(1971). (In German).

The taking into account of dynamic loads in the construction of nuclear power plants with regard to their safety is discussed for the following examples: earthquakes, shock pressure by explosions, and impact (e.g., aircraft crash). (GF)

Propulsion and Auxiliary Power Reactors

Refer also to abstracts 17731, 19065, and 19123.

19244 (DEU-72-5) INVESTIGATIONS FOR THE OPTIMIZATION OF REACTOR SHIELDS. Schnier, C. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht (West Germany)). 1970. 62p. (In German). INIS.

The optimization of the biological shield usually constructed in layers is made in two steps. First, the appropriate materials which are characterized by their shielding properties have to be selected and compiled in tables of quality classes. These supply information on material suitability for volume, weight and cost optimization. In this study, shields were investigated which consist of steel and water or lead and polyethylene. Second, the most favorable sequence of the materials in the laminated shield and the optimum layer thicknesses have to be determined. The more homogeneously the metal and water (polyethylene) are distributed the more efficient is the shielding effect. For shields with optimum volume and weight the three-layer arrangement (hydrogen-rich layer, metal-water (polyethylene)-mixture and hydrogen-rich layer) is demonstrated to be favorable. The biological shields of a planned high-temperature reactor for a ship HTR-S and of an advanced pressurized water reactor FDR, for ship propulsion are calculated for 3, 5 and 7 layers of iron and water. The calculated cases are compiled in diagrams which are arranged with respect to volume and weight optimization. (INIS)

19245 (DOCKET-50238-96) N. S. SAVANNAH. Technical Specifications, Change 13. (Maritime Administration, Washington, D. C.). 29 Jan 1973. 2p. Dep. NTIS.

Revised technical specifications are presented concerning safety aspects for the nonoperating condition of the reactor. (DCC)

19246 (LA-5113) SPACE ELECTRIC POWER R AND D PROGRAM. Quarterly Report for the Period Ending October 31, 1972. (Los Alamos Scientific Lab., N. Mex). Nov 1972. Contract W-7405-eng-36. 28p. Dep. NTIS.

Developments in the Thermionic Reactor Development Program are reported. Major efforts were the gathering of post-irradiation data on ceramic specimens and bonded ceramic-metal trilayers; fabrication of prototype ceramic-metal trilayers and pentalayers for future neutron-irradiation testing; planning, preliminary design, and initiation of a fast-neutron-spectrum thermionic-reactor critical experiment; and design and thermal analysis of two fueled-emitter irradiation capsules. Also reported are the effect of voltage at temperature on the electrical resistance of yttria-niobium trilayers; the performance-testing of isothermal-irradiator capsules; the development of $W-UO_2$ cermets with high volume fractions of UO_2; the thermal testing of fueled emitter configurations; and the results of electron-microprobe analyses of irradiated thermionic fuel-rod components. (auth)

19247 (N-72-25704) THERMIONIC REACTOR ELECTRIC PROPULSION SYSTEM REQUIREMENTS. Mondt, J. F.; Sawyer, C. D.; Schaupp, R. W. (Jet Propulsion Lab., Pasadena, Calif.). 1 Jun 1972. Contract NAS7-100. 27p. (NASA-CR-126867; JPL-TM-33-549). NTIS.

Mission analysis, system analysis and mission engineering studies were conducted to find a single nuclear electric propulsion (NEP) system which would be applicable for a broad range of unmanned outer planet missions. The NEP system studied uses an in-core nuclear thermionic reactor as the electric power source and mercury bombardment ion engines for propulsion. Many requirements, which are imposed on the NEP system by the mission, were determined for the studies in the process of trying to find a single NEP system for many missions. The NEP system requirements are preliminary in nature and subject to small changes with further iterations between these types of studies and the technology program. It was determined that other applications for in-core thermionic reactors must also be considered in determining specific reactor requirements. It is concluded that a single thermionic reactor NEP system could be useful for a broad range of unmanned outer planet missions. It is proposed that thermionic reactor NEP system have: a power level in the range of 70 to 120 kW(e); a system specific weight of approximately 30 kg/kW(e); and a full power output capability of 20,000 hours. (auth)

19248 (N-72-26530) NUCLEAR ELECTRIC PROPULSION MISSION ENGINEERING STUDY DEVELOPMENT PROGRAM AND COSTS ESTIMATES, PHASE 2 REVIEW. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). 15 May 1972. Contract JPL-953104. 111p. (NASA-CR-127070; GESP-7074). NTIS.

The results are presented of the second six-month performance period of the Nuclear Electric Propulsion Mission Engineering Study. A brief overview of the program, identifying the study objectives and approach, and a discussion of the program status and schedule are presented. The program results are reviewed and key conclusions to date are summarized. Planned effort for the remainder of the program is reviewed. (STAR)

19249 (RT/FI-(72)23) GADOLINIUM AS A BURNABLE POISON FOR THE NAVAL REACTOR: CALCULATION OF FUEL BURNUP AND PLANNED TESTS IN SUPPORT. Mattucci, A.; Pistella, F. (Comitato Nazionale per L'Energia Nucleare, Rome (Italy)). 30 May 1972. 101p. (In Italian). Dep. NTIS (U. S. Sales Only).

Calculational methods developed at CNEN for fuel elements with burnable poisons have been applied to the investigation of the NPN core with Gd as a burnable poisons with the aim of: setting up a reference method for the design method by FIAT; designing and analyzing experiments to be performed in ROSPO with pins containing Gd_2O_3 in UO_2; and designing and analyzing irradiation experiments to be performed with samples containing Gd_2O_3 in UO_2. (auth)

19250 (TIM-715(Suppl. 2)) INPILE CAPSULE DESIGN OF THE URANIUM CARBIDE FUEL ELEMENT TEST SPECIMEN FOR TEST IN LITHIUM (PW 26-150 SERIES). Butler, E.; Mattrella, U. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 4 Oct 1962. Contract AT(30-1)-2789. 14p. Dep. NTIS.

Declassified 21 Oct 1971.

19251 (TIM-715(Suppl. 3)) INPILE CAPSULE DESIGN OF THE URANIUM NITRIDE FUEL ELEMENT TEST SPECIMEN FOR TEST IN LITHIUM (PW 26-220 SERIES). Butler, E. N. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 24 Oct 1962. Contract AT(30-1)-2789. 18p. Dep. NTIS.

Declassified 21 Oct 1971.

19252 (TIM-767(Suppl.2)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-45. Frank, J. E.; Felber, F. F. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 17 Oct 1963. 10p. Dep. NTIS.

Declassified 22 Oct 1971.

19253 (TIM-780(Suppl.10)(Rev.1)) IN-PILE CAPSULE DESIGN REPORT FOR A UC FUEL SPECIMEN (TYPE 19E) OPERATING AT 2200F and 1.5 Kw/cc (A-He BARRIER). Black, J. R.; Mattrella, U. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 29 Apr 1964. Contract AT(30-1)-2789. 2p. Dep. NTIS.

Declassified 20 Oct 1971.

19254 (TM-66-3-22) NATURAL FREQUENCIES OF VIBRATION OF THE 710 FUEL ELEMENT. McConnelee, J. E. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation.). 25 Mar 1966. Contract AT(40-1)-2847. 8p. Dep. NTIS.

Declassified 4 Nov 1971.

Preliminary vibration analysis and test results are presented for the 37 channel and 91 channel 710 fuel elements. The results show good correlation between analysis and experiment. (auth)

19255 (WASH-1525) S8G PROTOTYPE, KESSELRING SITE, WEST MILTON, NEW YORK. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Dec 1972. 265p. Dep. NTIS.

The environmental effects of construction and operation of the Submarine Reactors (S8G Prototype) are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, and (6) the benefits-cost analysis of the proposed reactor operation. (DCC)

19256 CONDENSATION OF THE VENTING STEAM IN THE WATER. A Study of the Pressure Suppression System for Marine Reactors. Kozeki, Moribumi (Mitsui Shipbuilding and Engineering Co. Ltd., Tokyo). Mitsui Zosen Giho; No. 74, 2-12(Apr 1971). (In Japanese).

For the application of the pressure suppression containment concept to integrated marine reactors, the mechanism of condensation of the venting steam at the exit of the vent tube, the necessary submergence depth of the vent tube, and the effects of ship's attitude were experimentally investigated under the condition that the saturated steam (air content from 0 to 50%, pressure from 0.5 to 2 kg/cm^2 g) was vented through an orifice (diameter from 2 to 15 mm) into water (atmospheric pressure, subcooled to 60°C) using microflash-photography and high speed films. There are two patterns of venting; periodic venting and continuous venting. The transition from periodic venting to continuous venting appears when the ratio of the atmospheric pressure to the venting steam pressure is nearly critical. The collapse of steam bubbles is very rapid and the equivalent condensation heat transfer coefficients at the surface of collapsing steam bubbles are from 20 to 30×10^4 $kcal/m^2h^0c$. This value decreases when the air content in the steam increases. A formula for estimating the necessary vent tube submergence is given from the data obtained. Particular features are shown for steam vented upward, downward, etc., and all of these seem to be useful if the sufficient mixing of the water is affected. (auth)

19257 OUTLOOK FOR COMMERCIAL OPERATION OF NUCLEAR SHIPS. Results of Joint Japan-Germany Studies. Kinoshita, Masao (Hitachi Shipbuilding and Engineering Co. Ltd., Osaka). At. Jap.; 16: No. 6, Suppl., 68-76(Jun 1972). (CONF-720341-7).

From 5th Annual Conference of the Japan Atomic Industrial Forum; Tokyo, Japan (22 Mar 1972).

The background of joint studies of nuclear ships by Japan and Germany is first explained, and a series of studies carried out in both countries is discussed. Final agreement on the results of these studies was made in March 1972 between the two parties. These agreements are described. An 80,000-horsepower full container ship, for service between Far East and Europe, was chosen as the subject of study. Each party worked out its own design for nuclear-powered vessels, and a final comparison between them was carried out. It was assumed that plants for the respective ships will be equipped with West German-developed EFDR-80 reactors. Various economic aspects of container ships were also studied jointly. Both Japanese and German negotiators agreed to the need for building a joint demonstration ship. (JA)

19258 OPERATIONAL RESULTS OF THE NUCLEAR SHIP OTTO HAHN IN 1971. Atomwirt., Atomtech.; 17: No. 9-10, 499-500(1972). (In German).

During 1971, the Otto Hahn was essentially used as a freighter. In 17 voyages, a total load of 145,720 tons, mostly raw phosphate, was carried. Minor incidents and their treatment are described. During the voyages, significant research programs were conducted, such as systematic studies about the power behavior of the steam producer, a new thermodynamic study of secondary installations, successful experiments about water control, and several programs concerning reactor dynamics. With respect to the latter, studies centered on fuel temperature, reactivity conditions, xenon poisoning, and transient behavior. (HBG)

Process Heat and Desalination Reactors

Refer also to abstract 19066.

19259 (JUL-839-RG) WORK DONE BY FLUIDS IN BURSTING PRESSURE VESSELS. A COMPARISON OF THE BURST DANGER OF PRESSURE VESSELS BETWEEN WATER REACTORS AND THE PROCESS HEAT REACTOR. Barnert, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Mar 1972. 46p. (In German). Dep. NTIS (U. S. Sales Only).

For the purpose of making a comparison between the steam-generator pressure vessel of a process-heat reactor PR 500 and the reactor pressure vessels of a Boiling Water Reactor (BWR) and a Pressurized Water Reactor (PWR), a pessimistic estimation is made on the magnitude of the work done by fluids in bursting pressure vessels. This value is of decisive influence on the disturbing effects during bursting of vessels. It is found that the work done by the inventory of the reactor pressure vessel of a BWR is 200 times higher than that of the helium inventory in the steam-generator pressure vessel of the process-heat reactor PR 500. This is explained by the fact that the isentropic compressibility of steam is higher than that of helium. Other important differing characteristics are given for the steam-generator pressure-vessel of the process-heat reactor PR 500 and the reactor pressure vessel of water reactors. (auth)

19260 (STI-PUB-300(Vol.6)) PEACEFUL USES OF ATOMIC ENERGY. VOLUME 6. PROCEEDINGS SERIES. PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE HELD IN GENEVA, SWITZERLAND, SEPTEMBER 6-16, 1971. (International Atomic Energy Agency, Vienna (Austria)). Mar. 1972. 518 p. (In several languages). (CONF-710901-Vol.6). IAEA $14.00.

From 4th International Conference on the Peaceful Uses of Atomic Energy; Geneva, Switzerland (6 Sept 1971).

Papers are presented on small and medium power reactors, nuclear energy for desalination and agro-industrial complexes, utilization of research reactors, and impact of nuclear technology in developing countries. A separate abstract for each paper was included in NSA Volume 25, Issues 16 and 22. (HDR)

19261 UTILIZATION OF SOLID HEAT CARRIERS IN COAL GASIFICATION USING NUCLEAR ENERGY. Adams, H. W. Aachen; Technische Hochschule (1971). 111p. (In German).

Thesis.

The heat produced in a high-temperature reactor can be utilized in endothermal chemical processes (such as, e.g., the gasification of solid fossil fuels by means of water vapor). One of the main problems encountered in this process is the separation of the process heat from the helium cooling cycle and the transport of the separated heat to the gasification reactor, for example, by means of solid heat carriers. The transfer and transport of the heat

through moving beds in externally heated pipes was studied. As the efficiency of the gasification process is determined among others by the amount of heat obtained in this way, the quantities of heat that can be separated from a gas cycle in the temperature range up to 1,200°C were examined. The calculations were carried out for sand and coke as the heat-carrying medium. (GF)

19262 PROSPECTS OF A DUAL-PURPOSE NUCLEAR PLANT FOR MEETING WATER AND POWER REQUIREMENTS OF THE GREATER KARACHI AREA. Kamal, I. (Pakistan Atomic Energy Commission, Karachi). Nucleus (Karachi); 9: No. 1-2, 23-31(1972).

The PAEC proposes to undertake a detailed feasibility study of a dual purpose power and desalination plant to be located in the Greater Karachi area. The existing and future power and water requirements are discussed. 13 references. (auth)

19263 DESALINATION OF WATER. Vanaja, T. S.; Ramachar, T. L. J. Inst. Eng. (India); 52: No. 2, 44-56(1972).

The principles and processes of desalination are presented with reference to techniques such as distillation, freezing, electrodialysis, reverse osmosis and the theoretical aspects of such technology. Information is included on: materials of construction such as copper-nickel alloys, aluminum, steels, and titanium; design considerations; nuclear desalination as an attractive proposition for some areas in India; applications; economics; and future trends. It is concluded that desalination should be seriously considered, in spite of the present costs, for civilian consumption at least for regions where there is no other source of water supply or where transportation costs are prohibitive, and for emergency defense requirements. (Indian Sci. Abstr.)

Research and Test Reactors

Refer also to abstracts 17304, 17320, 17950, and 19260.

19264 (AAEC/E-236) COMPARISON OF MEASURED AND CALCULATED $^{238}U/^{235}U$ FISSION RATE RATIOS FOR NATURAL UO_2 ROD-CLUSTER FUEL ELEMENTS IN THE ZERLINA REACTOR. Durance, G.; McCulloch, D. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1972. 20p. Dep. NTIS (U. S. Sales Only).

Experimentally measured values of the $^{238}U/^{235}U$ fission rate ratio δ_{28} in uranium dioxide cluster fuel elements in a heavy water moderated, light water cooled reactor lattice configuration are compared with the predictions of one-group Monte Carlo cell calculations (MONTE), corrected for the actual experimental environment. A comparison between MONTE and WIMS calculations for the experiments is also given. (auth)

19265 (AEEW-M-1126) APPLICATION OF AN ON-LINE COMPUTER TO PHYSICS EXPERIMENTS IN ZEBRA. Marshall, J. (Atomic Energy Establishment, Winfrith (England)). Oct 1972. 24p. Dep. NTIS (U. S. Sales Only).

The Argus-500 Computer system installed on the zero-power fast reactor ZEBRA is described. Applications to on-line experimental data acquisition and processing include neutron spectroscopy, determination of reactivity by doubling time and inverse kinetics analysis, and reaction rate measurements. (auth)

19266 (AI-AEC-Memo-12661) FAST FLUX TEST FACILITY UNSHIELDED SODIUM COOLED FUEL HANDLING MACHINE PROGRESS REPORT. Jones, C. E.; Faitel, J. R. (Atomics International, Canoga Park, Calif.). 22 Jul 1968. Contract AT-(04-3)-701. 197p. Dep. NTIS.

Secondary cooling system concepts were studied for the unshielded sodium cooled fuel handling machine (USC FHM). These concepts are simplified and more reliable than those conceived to date for the shielded sodium cooled fuel handling machine (SSC FHM). Ten candidate secondary cooling system configurations or methods were surveyed. One configuration was selected for in-depth study. Three concepts of the selected cooling configuration were developed and are discussed in detail. The unshielded fuel handling machine concepts utilize reactor hot cell atmosphere (gas) as the secondary cooling system media. A forced gas system is used for cooling during normal operation, with a natural convection gas system used as a backup. The differences between the three concepts are in the detailed mechanical arrangements. The USC FHM can be used to transport FFTF reactor core components with decay heats of up to 30 kW(t). The maintenance, development, safety and costs of the concepts were investigated. These three concepts satisfy Reactor Refueling System (RRS) design requirements for FFTF service. (auth)

19267 (BNL-17504) DIRECT COOLING OF THE COLD NEUTRON MODERATOR BY HELIUM. Dean, J. W.; Jensen, J. E. (Brookhaven National Lab., Upton, N. Y.). 5 Jan 1972. 34p. Dep. NTIS.

A scheme for providing a moderator for cold neutron production in the HFBR is presented. Hydrogen is to be condensed into a 1.3 liter elliptical container located in-pile. Gaseous helium near 14 K passes through tubes in contact with the container to provide refrigeration for condensing the hydrogen, intercepting the thermal heat load, and removing nuclear heating. Refrigerator operating characteristics and heat transfer calculations are presented. (4 references) (auth)

19268 (BNWL-CC-362) INTERIM REPORT ON HTLTR MOCKUP RUN NUMBER 2. Kreiter, M. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 22 Nov 1965. Contract AT(45-1)1830. 28p. Dep. NTIS.

Results are presented from Run Number 2 of the large mockup for research and development in support of the High Temperature Lattice Test Reactor. Based on high water concentrations and extensive graphite corrosion observed in Run Number 1, it was decided the primary objectives of Run Number 2 would be to (1) investigate the effect of cleanup towers in the recirculating gas system on gas compositions within the system; (2) determine the extent of graphite damage at a reduced core temperature of 700°C, which is slightly below the threshold of the water-graphite reaction; and (3) check operability of the control rod and safety blade under heated conditions. Additional items included for study were (1) comparison of contaminant gas removal during the initial evacuation–nitrogen fill cycles with Run Number 1; (2) performance of the graphite heating element components; and (3) integrity of Inconel-sheathed chromel–alumel thermocouples. (auth)

19269 (BNWL-CC-425) INTERIM REPORT ON HTLTR MOCKUP RUN NUMBER 3. Kreiter, M. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 7 Jan 1966. Contract AT(45-1)1830. 27p. Dep. NTIS.

Results are presented from Run Number 3 of the large mockup for research and development in support of the High Temperature Lattice Test Reactor (HTLTR). Run Number 2 demonstrated that the mockup could be operated at 700°C with negligible graphite damage. The next step in the series of mockup operational runs was to determine the integrity of the control rod, safety blade, heating elements, and thermocouples at the HTLTR design temperature of 1000°C. The 1000°C run was of short term (250 hour) to permit early detection and rectification of any gross malfunctions of the equipment being tested. Also, information supplementing data gathered during previous experiments was obtained. (auth)

19270 (BNWL-CC-997) INTERIM REPORT ON HTLTR MOCKUP RUN NUMBER 4. Kreiter, M. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 20 Feb 1967. Contract AT(45-1)1830. 34p. Dep. NTIS.

Results are presented from mockup Run Number 4. The mockup was designed and built for research and development in support of the High Temperature Lattice Test Reactor (HTLTR). Run 4 was the final scheduled run in the test series and was performed to determine the integrity of the control rod, safety blade, heater elements and thermocouples when exposed to a graphite core temperature of 1000°C for a period of 42 days. This is estimated to be the equivalent of approximately four years of accumulated operating time at 1000°C in the HTLTR. It was believed that if the components on test survived a test of this duration they would be satisfactory for use in the reactor. (auth)

19271 (CEA-CONF-2093) DETERMINATION OF IRRADIATION PARAMETERS OF FUEL IN TEST REACTORS. Labrousse, M.; Baudry, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1972. 9p. (In French). (CONF-920971-1). Dep. NTIS (U.S. Sales Only).

From 32nd Euratom Group Dosimetry Conference; Rome, Italy (20 Sep 1972).

The power distribution during irradiation of a fuel element mock-up in a testing reactor is defined. Until now, activation detectors have been used but accuracy is rather low and such detectors cannot be easily used with plutonium fuel. The fission rate of a fuel element is obtained by comparing fission products activities of the actual fuel element and of a reference fuel sample irradiated at the same time in a thermal cloumn. In such a pure thermal neutron flux, the fission rate can be easily deduced from the neutron flux and thermal cross section of a dilute absorber used as a reference. To perform activity measurement, fuel samples are dissolved by nitric acid, then counts can be made with liquid sources. Three kinds of irradiations are analyzed: 1. Light water reactor fuel element. 2. Fast reactor fuel element. Since it is impossible to declad a plutonium pin, it will be irradiated at the same time and in the same place as a uranium oxide fuel pin. The first step is to compare the activity of the two pins with a gamma

scanning device, then the uranium pin is analyzed in the usual way. 3. High Temperature Reactor fuel element. In addition to the fission rate measurement, it is necessary to measure the effective cross sections of ^{238}U (by conversion ratio measurement) and ^{239}Pu; since irradiation is carried out inside the core of the testing reactor it is necessary to obtain this data in order to calculate the power distribution during irradiation time. At the same time as the experiments were performed, different computer codes were used to calculate effective cross sections and power distribution. (auth)

19272 (CEA-N-1571) LIQUID-HYDROGEN MODERATOR: CHANNEL H^5 EL 3. Der Nigohossian, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov 1972. 95p. (In French). Dep. NTIS (U.S. Sales Only).

Following a summary of the principles of low temperature neutron moderators, the construction and operation of a liquid hydrogen cold neutron source which is used in the channel H^5 of the EL 3 reactor at Saclay is described. The use of thermally induced hydrogen circulation and of a Philips gas refrigerator results in important simplifications and increased safety compared to existing systems. The problems met and the techniques employed are described. (auth)

19273 (EANDC(OR)-114-U) RESEARCH PROGRAMS WITH SMALL REACTORS. Carvalho, F. G. (ed.) (Junta de Energia Nuclear Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). Jul 1972. 210p. (CONF-711062).

From Topical conference on research programs with small reactors; Sacavem, Portugal (13 Oct 1971).

Research programs for small research reactors are reviewed. Research programs are described for the following countries: Austria, Belgium, Denmark, Portugal, Spain, Sweden, Switzerland, and U.S.A.. (auth)

19274 (EUR-4639(Pt.1)) HFR INFORMATIONS FOR USERS. HFR INFORMATION ON HFR FACILITIES. Snepvangers, J. J. M.; Zijp, W. L. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). 1972. 26p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 40.-.

A brief survey of the high flux reactor principal facilities and corresponding irradiation devices available for nuclear materials testing experiments is presented. Included is general information on the reactor and its performance, together with isotope production and ancillary facilities and the means available for materials testing for water and for high temperature reactors. Special attention is focussed on the devices recently developed in the field of direct in-pile measurements, in particular for the study of the mechanical properties of various nuclear materials exposed to high neutron flux densities. (auth)

19275 (EUR-4639(Pt.2)) HFR INFORMATIONS FOR USERS. SURVEY OF THE HIGH FLUX FACILITIES IN THE HFR PETTEN, SELECTED FOR HTGR MATERIALS TESTING. Zeisser, P. R. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). 1972. 34p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 50.-.

19276 (EUR-4639(Pt.3)) HFR INFORMATIONS FOR USERS. SURVEY OF HIGH FLUX FACILITIES IN THE HFR PETTEN, AVAILABLE FOR FAST REACTOR MATERIALS TESTING. Zeisser, P. R. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). 1972. 31p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 40.-.

19277 (EUR-4639(Pt.4)) HFR INFORMATIONS FOR USERS. SURVEY OF HIGH FLUX FACILITIES IN THE HFR PETTEN, SELECTED FOR BOILING WATER AND PRESSURIZED WATER REACTOR (BWR AND PWR) MATERIALS TESTING. Markgraf, J. (European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Center). 1972. 40p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 50.-.

19278 (GEAP-13713) INSTRUMENTED FUEL ASSEMBLY FABRICATION REPORT. Craig, E.; Gregg, J. P.; Hall, W. L.; Kubic, B. W.; Lannin, T. E.; Mine, W. T.; Thompson, M. L. (comps.) (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jun 1972. Contract AT(04-3)-540. 182p. Dep. NTIS.

From Southwest Atomic Energy Associates.

The development of an instrumented fuel assembly for the Southwest Experimental Fast Oxide Reactor is reported. The development is described in detail under the headings fabrication and assembly objectives and description, component description, fabrication process development, subassembly fabrication, assembly, and packing and shipping. (JWR)

19279 (GEAP-13771-4) CRITICAL EXPERIMENTS AND COOPERATIVE EVALUATIONS PROGRAM. Fourth Quarterly Report, July–September 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Sep 1972. Contract AT-(04-3)-189. 48p. Dep. NTIS.

Current activities and technical progress for the period July through September, 1972, are reported for two tasks. Task A covers the planning and analysis of critical experiments in ZPPR-3. Task B progress is reported for nuclear data evaluation and testing and methods development in support of Task A. (7 references) (auth)

19280 (HEDL-TME-72-107) FFTF MATERIALS ARCHIVE PROGRAM. Moen, R. A. (ed.) (Hanford Engineering Development Lab., Richland, Wash.). Dec 1972. Contract AT(45-1)-2170. 82p. Dep. NTIS.

A reference for the FFTF Materials Archive Program is presented. This reference will be used in all future communications concerning the Archive and will provide a historical review of the evolution of the Program as well as a current reassessment of criteria and specific requirements for archive materials. The document will provide a vehicle for documenting what is placed in the Archive and what has been removed from the Archive. Case histories of component materials problems which have involved the withdrawal and testing of Archive material will be added as they become available. The material certification records on all materials in the Archive can be summarized in various ways by properly programming for retrieving the computer-stored data. These data can be included and could be very useful to the material technologist as well as to the designer of future reactor plants. (auth)

19281 (HEDL-TME-72-147) INVESTIGATION OF MODELLING METHODS FOR FTR BURNUP CALCULATIONS. Nelson, J. V.; Bennett, R. A.; Fleishman, R. M. (Hanford Engineering Development Lab., Richland, Wash.). Dec 1972. Contract AT-(45-1)-2170. 54p. Dep. NTIS.

The results of an investigation of the importance of different modelling parameters on calculated burnup data for the Fast Test Reactor (FTR) are presented. These parameters include energy group structure, number of axial and radial burnup regions in the core, time step length, control rod treatment and geometry. Also, the effect of ^{239}Np buildup was studied. The purpose of this investigation was to establish criteria for formulating FTR burnup models adequate for the development of a Reactor Surveillance Procedure for FTR operations. (auth)

19282 (HEDL-TME-72-148) DYSI: DYNAMIC SLUG IMPACT SIMULATION FOR THE FFTF. Madsen, R. N.; Simpson, D. E. (Hanford Engineering Development Lab., Richland, Wash.). Dec 1972. Contract AT(45-1)-2170. 68p. Dep. NTIS.

The DYSI simulation models the dynamics of a fluid slug impact against the head of a cylindrical vessel. The simulation is a completely coupled system representing the head, bolting system, compliant underhead material and the region of the vessel affected by the fluid slug; deformations of the system are computed in response to forces and pressures which are themselves calculated as a function of the dynamic response of the system. The model is a one-dimensional point-mass simulation which results in a large set of ordinary differential equations with associated functions that are solved by the MIMIC computer code. (auth)

19283 (JPRS-57632) CONTEMPORARY RESEARCH REACTORS. Khristoforova, R. F. Translated from Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 3, 20-7(1972). 11p. Dep. NTIS.

A description of the physics parameters and performance characteristics of Soviet high-flux reactors is presented. 21 references. (auth)

19284 (JUL-884-RE) EXAMINATION OF THE RADIATION SAFETY OF THE FRJ-1 (MERLIN) REACTOR AFTER RAISING THE POWER TO 10 MEGAWATTS. Jahn, H.; Laumen, K. J. (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren). Aug 1972. 57p. (In German). Dep. NTIS (U. S. Sales Only).

The thermal power of the research reactor FRJ-1 was increased from 5 to 10 MW. On the tank reactor, with light water as cooling medium and moderator, measurements were performed about γ- and neutron doses as well as the concentration of radioactive gases in the reactor building and in the emitted air. Results showed that the reactor could be operated safely up to a power of 10 MW. In addition, safety experiments were performed which showed that, even in the most unlikely case of a 65% water loss from the primary system, no serious radiation hazards would exist to personnel. (H.B.G.)

19285 (ORNL-TM-4010) ABSOLUTE NEUTRON SPECTRUM EMERGING THROUGH A 15¼-IN. COLLIMATOR FROM THE TSR-II REACTOR AT THE TOWER SHIELDING FACILITY. Maerker,

R. E.; Muckenthaler, F. J. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 7p. Dep. NTIS.

The neutron spectral intensities in a 100-group structure and the angular distribution emerging from the TSR-II reactor through the 15-1/4-in. tapered collimator at the Tower Shielding Facility are presented. These data may be used as free-field source terms in the calculations of experiments performed using this collimator, and were derived from many different measurements made at various positions along the beam centerline. (auth)

19286 (SC-RR-720904) PRELIMINARY SPR III SAFETY ANALYSIS REPORT. Coats, R. L.; Jefferson, R. M. (Sandia Labs., Albuquerque, N. Mex.). Nov 1972. 42p. Dep. NTIS.

Information on the Sandia Pulsed Reactor III is presented concerning the reactor site, facility, design parameters, operating characteristics, safety considerations, quality assurance program, development programs, and emergency plans. (DCC)

19287 (TM-64-10-705) TEST PROGRAM AND PROCEDURES FOR THE NASA INSERT TEST IN THE 630A CRITICAL EXPERIMENT REACTOR. Pincock, G. D. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 21 Oct 1964. 19p. Dep. NTIS.

Declassified 3 Nov 1971.

The test program and procedure are presented for a series of measurements to be made in the 630A critical experiment reactor after replacing the center 19 fuel cell region with an insert containing 37 fuel cartridges of NASA design. Six different insert arrangements will be tested. Measurements include reactivity, power distribution and relative neutron flux measurements. (auth)

19288 FUTURE OF THE ESSOR REACTOR. Bonnaure, P. (EURATOM, Ispra, Italy). Ind. At. Spatiales; 16: No. 4, 47-60 (Jul 1972). (In French).

Following an intensive program aimed at adapting the Essor reactor for the irradiation projects currently of interest in the European nuclear industry, this installation is now available to organizations concerned with the development of light water, heavy, and high temperature reactors. The research facilities offered by this plant which integrates a large test reactor with hot laboratories are outlined. (FR)

19289 RADIATION CONTROL AT THE IRT-2000 NUCLEAR REACTOR AT SOFIA. Mishev, I. T.; Gelev, M. G. At. Energ. (USSR); 34: No. 1, 44-46(Jan 1973). (In Russian).

The principal biological shield at the Sofia IRT-2000 reactor consists of water and dense concrete, and supplementary shielding at experimental channels is provided in the form of water, paraffin, and concrete. Measurements were made of the maximum possible annual doses of thermal neutrons, fast neutrons, and of γ-radiation which could be received by an individual worker behind this supplementary shielding at five channel locations. In some cases as many as three different positions at a given experimental channel were checked for dose rate. It was concluded that the individual dose of radiation as received by one person during ordinary work at the Sofia reactor does not exceed one BER ±30% per year. (KSW)

19290 CHOICE AND SAFETY ANALYSIS CONCERNING THE INSTALLATION OF A 140Mw FAST NEUTRON REACTOR. Amadesi, P.; Cazzoli, S.; Cucchi, G. (Comitato Nazionale per l'Energie Nucleare, Bologna). pp 831-52 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection: Bordeaux, France (27 Mar 1972). See CONF-720328.

Three sites proposed for the construction of the 140 MW reactor PEC (Brasimone, Casaccia and Rotondella) were examined. These sites were analyzed on the basis of diagrams representing the doses received by the population from a predefined reference nuclear accident. Sixteen sectors around each site were considered, the following factors being envisaged: inhaled dose; collecting of radioactive material in clouds; soil deposits; resuspension and ingestion in foods. Plutonium risks were also considered. The dose diagrams were examined in conjunction with a matrix having the following variables: rejection height, wind speed, vertical temperature gradient, meteorological category frequence of each of the meteorological parameters examined and the slope of ground. As a result of the analysis carried out on the risk-probability matrix, the Brasimone site was chosen because of the relatively small risk it involves. A detailed safety analysis was carried out for this site, estimates being made of the absolute dose received by the population following the reference accident. The different ways in which this dose can be received were considered: radioactive cloud; critical pathways through which radioisotopes enter the human organism; or as a result of direct radiation from the vessel. (auth)

19291 MODERNIZATION OF THE REACTOR VVR-K AND ITS UTILIZATION IN THE NATIONAL ECONOMY OF KAZAKHSTAN. Takibaev, Zh. S.; Ibragimov, Sh. Sh.; Batyrbekov, G. A.; Okolovich, V. N. Vestn. Akad. Nauk Kaz. SSR; No. 2, 15-26(Feb 1972). (In Russian).

The nuclear reactor VVR-K is described, and details are given on its design, and on the changes which have been introduced for the purpose of enhancing its experimental capabilities. A brief review of research conducted in the reactor and some pertinent results obtained are presented. Future research and development work is outlined. (tr-auth)

19292 SOME MEASUREMENTS OF NEUTRONIC FLUCTUATIONS IN THE HIFAR REACTOR. Harris, R. W.; Ledwidge, T. J. (Australian Atomic Energy Commission, Sydney). Nucl. Eng. Des.; 22: No. 1, 359-63(1972).

The analysis of the neutronic fluctuations in the HIFAR (High Flux Australian Reactor) reactor at full power yields a spectral density whose shape at low frequencies is in good agreement with that expected from white noise excitation of a system whose dynamics are explainable in terms of a point reactor model. Using the point reactor model and the measured spectrum, the prompt neutron lifetime was estimated as 610 ± 50 μsec. This value is in good agreement with that obtained in previous studies where the input was determined by oscillating a cadmium cylinder within the core. An anomalous peak was noted in the power spectral density of the neutronic fluctuations. An out-of-pile mechanical vibration test of a spare control arm showed that its fundamental frequency was very close to the observed anomalous peak. The peak was ascribed to the effect of flow induced vibration of the in-core control arms. (auth)

19293 DETERMINATION OF THE THERMAL NEUTRON FLUX DENSITY IN THE BULK SHIELDING EXPERIMENTAL TANK OF THE TRIGA MARK-II REACTOR USING SOLID STATE TRACK RECORDER. Yoo, Y. S.; Ro, S. G. (Atomic Energy Research Inst., Seoul). J. Korean Phys. Soc.; 5: No. 1, 22-8 (Mar 1972).

The horizontal spatial variation of the thermal neutron flux density in the Bulk Shielding Experimental Tank of the Korean TRIGA Mark-II Reactor has been determined using a solid state track recorder of domestically produced natural mica placed next to ^{235}U fissile foil, with the reactor operating at a steady power of 250 kW. Counting the induced fission damage tracks in the mica with the help of an optical microscope makes possible the calculation of the thermal neutron flux density. The results are given in tabular and graphical forms. The range of neutron fluence capable of being measured has been estimated to be about 2.03×10^6 to 2.03×10^{10} n/cm^2 for the mica and 3.99 μg/cm^2 thick ^{235}U fissile foil. 20 references. (auth)

19294 AUTOMATIC OPENING AND CLOSING OF THE REACTOR CHANNEL IN THE SYSTEM OF NEUTRON SPECTROMETER. Mijailovic, K. (Boris Kidric Inst. of Nuclear Research, Belgrade). Meh. Automat.; 4: No. 18, 33-4(1971). (In Serbian).

The automatic programmed operation of the CHANNEL unit three-crystal neutron spectrometer is described. The unit enables measurements of the scattered neutrons when the reactor channel is opened and closed (by Cd moderator) in order to determine the ratio between the fast and thermal neutrons. The automatic opening and closing of the reactor channel and the automatic operation of the spectrometer greatly raise the efficiency of the experiment. (auth)

19295 USE OF SOLID STATE TRACK RECORDERS FOR THE MEASUREMENT OF FISSION RATE RATIOS IN REACTOR LATTICES. Richmond, R.; Rueegger, B. (Federal Inst. for Reactor Research, Wuerenlingen, Switzerland). Neue Tech.; No. 10, 1-8(1971).

A series of measurements of the neutron physics properties of fast reactor lattices is about to begin in the reactor PROTEUS. These measurements include the determination of the relative fission rates in the fissile nuclides in the fuel elements. Each fission rate is measured by means of a solid state track recorder which is inserted into a fuel element adjacent to a foil of fissile material and records a track density proportional to the fission rate in the foil. The need to count large numbers of tracks in order to obtain adequate counting statistics rules out the possibility of counting by eye and the only automatic method of sufficient accuracy is automatic image analysis. A Quantimet 720 is used to determine the fission track densities. An investigation of the various sources of error arising in the measurement has shown that it is possible to obtain the ratio of the track densities on two recorders with an error of the order of ±1%. One of the most important factors in achieving this accuracy is the correct determination of the fraction of counts lost as a result of track overlapping and it has been dem-

onstrated that this loss correction can be determined with adequate accuracy for track densities up to 2000/mm^2. 8 references. (auth)

19296 VIBRATION AMPLIFICATION BY REPETITIVE PULSING OF RAPIDLY HEATED CYLINDERS. Grossman, R. J.; Hamilton, L. J. (Univ. of Michigan, Ann Arbor). Nucl. Eng. Des.; 23: No. 1, 39-52(1972).

The fuel elements of a repetitively pulsed fast reactor are subjected to rapid heating in a time short with respect to their mechanical response time. As a result, vibration of the fuel elements occurs and, under certain conditions, these vibrations may be amplified considerably. An experimental investigation of the amplification which occurs when a thin wall, hollow, stainless steel cylinder is repetitively heated internally by Joule heating is described. The results show that significant amplification of the vibrations can occur. The experimental technique is a variation of the resonance method for measuring natural frequency and internal damping. The apparatus could be adapted for use as a materials testing facility for high cycle, low stress fatigue studies since relatively large stresses could be induced with a rather small energy deposition per pulse. 10 references. (auth)

19297 ANALYSIS OF SEFOR TRANSIENTS. Bogensberger, H. G.; Oosterkamp, W. J. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 17: No. 9-10, 505-6(1972). (In German).

The Southwestern Experimental Fast Oxide Reactor experiments demonstrated impressively that the Doppler effect is very well suited for the catching of rapid power excursions. Through this fact, the safety system gains sufficient time to exert its controlling action. An exact determination of the Doppler coefficient, however, is possible only to a limited degree. This limitation results from the fact that the power behavior is closely associated with parameters possessing uncertainties, such as neutron lifetime, mean decay constant, and expansion effects. (HBG)

19298 DETERMINATION OF THE ABSORBED DOSE AND THERMAL NEUTRON FLUX USING A LOOP ARRANGEMENT. Abdukadyrova, I. Kh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 84-6 (1972). (In Russian).

Chemical dosimetry was utilized in absorbed dose measurements in the canal of a nuclear reactor. The working substance for the dose level measurement was a 9% aqueous solution of glucose. The thermal neutron level was obtained by introducing a boron-containing substance in the operating solution of a loop so as to provide either 0.1 or 0.18 M B, and obtain a $^{10}B(n,\alpha)^7Li$ reaction. The deviation of the average flux values obtained from chemical dosimetry and from activation methods did not exceed 10%. (KSW).

19299 RADIATION FIELD OF THE SIEMENS TRAINING REACTOR SUR 100. Keinert, J.; Meamari, E. (Univ., Stuttgart). Atomkernenergie; 20: No. 2, 105-10(Oct 1972). (In German).

The Siemens Training Reactor is well suited to test numerical results of calculations by transport theory with measurements of some interesting data as dose rates of neutrons and of gamma radiation. The calculation was done in two steps with the S_N-code ANISN. First a calculation with the cross sections of the IKE 49 neutron group cross section library THERM 49A yielded the unknown fission sources in the reactor core. In the second step a shielding calculation with this volume source was done with the mixed n, γ-cross section library NEU 50 G1 (36 neutron groups, 12 gamma groups). This calculation yielded the neutron- and gammaflux densities in as well as outside of the reactor containment in the investigated directions. Further with this flux density data we calculated other interesting data as dose rates or average energies of the neutron and gamma radiation. The different measurements were done for determining the flux density shape inside of the reactor and the maximal radial and axial neutron and gamma dose rate outside. A comparison of the two methods yielded excellent agreement. This shows that the SUR 100 may well be calculated in a one-dimensional geometry for the chosen directions. 9 references. (auth)

19300 PHYSICS OF THE CORE OF THE POLYTECHNICAL UNIVERSITY'S TRAINING REACTOR. Szabo, F.; Frankl, J.; Valko, J.; Turi, L. (Central Research Inst. for Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 221-39(1972).

A brief description is given of the measurements and calculations of the ZR-5 project which worked out the nuclear design of the Polytechnical University's Training Reactor. The system of programs (the reactor physical model) used in the calculations is described together with some of the experimental techniques that have confirmed high precision and great potential value. It is emphasized that most nuclear aspects of reactor design and operation can be effectively studied with such a calculation model. (auth)

19301 SELF-LIMITING POWER EXCURSION CHARACTERISTICS OF LIGHT WATER REACTOR. IV. MEASUREMENT OF FUEL-CLADDING STRAIN. Inagaki, K.; Kato, H. (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 10, 584-91(Oct 1972).

A strain gage was used for the measurement of fuel cladding strain generated during pulse operation tests on the Hitachi Training Reactor. In the analysis of the measured strain, two kinds of correction were called for: (1) the radiation effect on the strain gage and lead wires, and (2) the temperature effect due to the lag of the gage filament temperature behind the true fuel cladding temperature. The experimental axial strain after the two corrections were applied was 781×10^{-6} cm/cm for the hottest fuel rod in the pulse operation test with an inserted reactivity of 1.20% Δk/k. This maximum strain corresponded to 2,169 kg/cm^2 of thermal stress and 111 cal/cm^2·sec of heat flux. These results were obtained under the condition of maximum temperature in the fuel center of 1,200°C and a fuel cladding temperature of 140°C. When the axial strain was calculated with consideration given to the gap or contact conductance between the fuel and its cladding, a reasonable agreement was obtained between the calculation and the experimental results. 16 references. (auth)

19302 CONTROLS FOR PURNIMA. Nucl. India; 10: No. 10-11, 9; 11(June 1972).

In the PURNIMA REACTOR, all control action is achieved through variation of neutron reflection efficiency, close to the core vessel. The primary protection device on which the safety of the system is based, is the core drop mechanism. Electromagnets, specially developed at the Bhabha Atomic Research Centre, Bombay, India, hold the core table carrying the core vessel and the bottom part of the inner copper reflector. The safety rods system serves as an additional independent shutdown arrangement, backing up the core drop mechanism. The core drop and safety rod mechanisms together remove reactivity at the rate of ~200$/sec. Digital position indication is provided for all the control rods. The accuracy of indication is 0.01 mm. Events which cause the reactor failures are summarized. (INIS)

19303 FUEL FOR PURNIMA. Nucl. India; 10: No. 10-11, 10-12(Jun 1972).

The detailed procedure followed, as well as the problems encountered, in the fabrication of plutonium oxide fuel elements for the Purnima reactor at the Bhabha Atomic Research Centre, Bombay, India, have been described. Plutonium being a powerful alpha emitter with an average energy of 5.15 MeV, a half-life of 24, 360 years and a low critical mass, various precautionary measures have been taken and these are enumerated. The mpc level of plutonium being 0.6 microgram, the handling of PuO_2 was strictly confined to gloveboxes maintained at negative pressures, to ensure that fine dust, if any, does not escape from the gloveboxes into the main system. The loading and arrangement of the fuel element and the remote handling system used are also explained. Safety measures adopted for avoiding leakage of radioactivity are summarized. (INIS)

19304 GUIDELINES ESTABLISHED FOR THE STRUCTURAL DESIGN OF THE EXPERIMENTAL FAST REACTOR JOYO. Ichino, I.; Abe, Y. Nippon Genshiryoku Gakkaishi; 14: No. 12, 678-693 (Dec 1972). (In Japanese).

Compared with light-water reactors, sodium-cooled fast reactors operate at higher temperature and lower pressure. Thus, high thermal stresses are induced in the structural components at steady as well as transient operation, while mechanical stresses due to internal pressure are comparatively low. The materials used for the structural components exposed to sodium are liable to creep under the stress, while the mechanical properties are further impaired by mass transfer in hot sodium circuits. Sodium-cooled fast reactors also differ radically in the principles that govern safety considerations and the composition of the coolant system. The design criteria of the components of such reactors are largely governed by these safety considerations and by the particularities of the coolant system. The guidelines established for the structural design of JOYO have involved these new problems which applied to all the sodium coolant system pressure boundaries including the core support structure. An outline is given of the guidelines established for the design. (auth)

Production Reactors

19305 (DUN-7923) OBSERVATIONS ON THE GAMMA ENERGY MONITORING SYSTEM. Kupinski, A. F. (Douglas United Nuclear, Inc., Richland, Wash.). 15 Apr 1972. 26p. Dep. NTIS.

The N Reactor rupture monitoring system is composed of two parts, the Gross Gamma Monitoring System (GGM) and the

Gamma Energy Monitoring System (GEM). The GGM system provides continuous surveillance of the gross gamma background for each process tube and forms the primary rupture detecting mechanism. The GEM system is capable of energy discrimination and provides supplementary information on spectrum and assists in identifying ruptures from discontinuities such as crud bursts and drastic flow changes. The performance of the GEM system has not entirely lived up to expectations due to large variations in the background signals between process tubes and an uncertainty in where the optimum energy range is for providing maximum sensitivity for rupture confirmation. Several observations on the GEM system related to sensitivity and optimization of signal output which can be used as a basis for further recommendations or a stimulus for additional investigation are presented. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 17728, 17735, 17737, 17741, 17776, 17777, 17787, 17788, 17790, and 17871.

19306 (FEI–248) APPROXIMATE METHODS OF CALCULATING A TRANSITIONAL TEMPERATURE FIELD OF FUEL ELEMENTS IN NUCLEAR REACTORS. Kuznetsov, I. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 38p. (In Russian). INIS.

Approximate methods are reviewed for the calculation of transitional temperature fields of fuel elements in nuclear reactors. Various methods treat thermal conductivity and determine the approximate heat transfer functions for fuel elements. A simple and accurate method is proposed for obtaining a series of coordinated approximations. These advantages are illustrated by calculation examples. Other approximate heat transfer equations and their solutions are based on variational methods and integral estimates. The solutions yield simple ultimate expressions, and a comparison of the approximate solutions with precise ones revealed only a slight error. (tr-auth)

19307 (HEDL-TME-72-125) CONTROL AND BEHAVIOR OF O/M AND OFFGAS DURING FABRICATION OF MIXED OXIDE $(U_{0.75}-Pu_{0.25})\ O_{2-x}$ FOR HEDL IRRADIATION TESTING. Chidester, K. M. (Hanford Engineering Development Lab., Richland, Wash.). Oct 1972. Contract AT(45-1)-2170. 29p. Dep. NTIS.

Ninety-five percent of all mixed oxide $(U_{0.75}-Pu_{0.25})\ O_{2-x}$ fuel batches fabricated at HEDL to oxygen-to-metal ratio (O/M) specifications of 1.95 ± 0.02 and 1.94 to 1.97 were found acceptable. Special techniques were explored for adjusting the O/M ratio to specific values both within and outside the specification ranges. The amount of sorbed gas in sintered fuel pellets was reduced to less than 0.04 cm^3/g by cooling in argon or vacuum. Room temperature oxidation of fuel pellets was discovered, with moisture as a major oxidant. Control techniques demonstrated to be effective in preventing room temperature oxidation (O/M drift) were storage in a rough vacuum (0.16 atmosphere) and storage in a gas sealed container free from moisture. (auth)

19308 (KFK–1648) AXIAL DISTRIBUTION OF SEVERAL FISSION PRODUCTS IN FUEL RODS OF THE IRRADIATION EXPERIMENTS DFR-350. Smailos, E.; Geithoff, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Oct 1972. 68p. (In German). Dep. NTIS (U. S. Sales Only).

The axial distribution of several fission products was determined by γ-spectrometry in 15 mixed oxide fuel pins from the irradiation experiment DFR-350. Large variations in the local concentrations were found for the nuclide ^{137}Cs. Two different distribution patterns were discernable, one having the maximum concentration at the upper end, the other with the maximum at the lower end of the fuel column. Coolant outlet temperatures during irradiation have been found to be low for Cs-enrichments at the bottom end of the pins while high temperatures correspond to enrichments at the top end. An explanation for this effect based on the reaction kinetics of cesium is offered. The distribution of the other nuclides measured has shown no peculiarities. The question whether cesium is movable within the pin even after the end of irradiation was tested in an experiment. A pin was heated in a temperature gradient ranging from 300° to 640°C for several hours. With this procedure the cesium could not be induced to move. By this way it is clearly established that slight temperature changes during postirradiation examination are not capable of moving the fission product cesium. (auth)

19309 (ORNL-tr-2665) STUDIES ON PRESTRESSED CONCRETE NUCLEAR REACTOR VESSELS. 1. MODEL EXPERIMENTS ON PCRV. Kamiya, Yoshiro; Nojiri, Yoichi. Translated by H. Kubota (Oak Ridge National Lab., TN), from Konkurito Janaru; 10: 1-11(Nov 1972). 31p. Dep. NTIS.

A method of three dimensional stress analysis for the design of prestressed concrete pressure vessels is described. The development of techniques for prestressed concrete pressure vessel model experiments is discussed. (auth)

19310 BUNDLE-TYPE FUEL ELEMENTS FOR A NUCLEAR REACTOR. Anthony, A. J.; Gruber, E. A. (to Combustion Engineering, Inc.). German Patent 1,539,821. 18 May 1972. (In German).

The fuel element is composed of many fuel rods arranged in parallel and fixed by polygonal carrier end plates. The guide rods determining the clearance between each of these carrier plates are arranged so as to extend over the cross section of the fuel element in order to serve as gliding planes for the control rods to prevent them from touching the fuel rods. Depending on the shape of the polygonal end plate, at least one or two guide rods are required for this purpose. (GF)

19311 IN-PILE LOOP CHANNEL WITH NATURAL COOLANT CIRCULATION FOR FUEL ELEMENT TESTING. Klochko, G. A.; Kurov, V. A.; Maksimenko, V. I.; (and others). At. Energ. (USSR); 34: No. 1, 40-42(Jan 1973). (In Russian).

A special compact test loop was designed and fabricated for the purpose of investigating new types of fuel elements under reactor conditions. The parameters of the water-cooled loop are tabulated and include: 28 kW power level, 1.3×10^6 watts/m^2 flux from the fuel element surface, linear velocity of coolant of 0.36 m/sec, and a consumption of 2.5×10^3 kg cooling water/hr. (KSW)

19312 THERMAL CHARACTERIZATION OF RESTRUCTURED FUEL. Friedland, A. J. (Atomic Power Development Associates, Inc., Detroit). Nucl. Sci. Eng.; 50: No. 1, 85-7(Jan 1973).

Three-region restructured fuel, with given thermal characteristics, may be represented by an effective conductivity integral function Y(T). For any fuel surface temperature T_s and linear heat generation rate q, the maximum fuel temperature T_v is found from the relation $Y_v - Y_s = q$. Region radii and molten fuel fraction appear in the groups qR^2/R_f^2 and qF as functions of $Y_v - Y_e$. (auth)

19313 CHOICE OF METALLIC MATERIALS. Thirteenth Colloquium on Metallurgy, Saclay, France, June 25, 1970. Paris; Masson (1972). 188p. (In French). (CONF-700672).

Nineteen papers were presented at this conference. Seven of them were abstracted for NSA. These papers include studies on fuel elements and fuel claddings. (FR)

For abstracts of individual papers see: 19095, 19114–19117, 19146, and 19314.

19314 CLUSTER TYPE FUEL ELEMENTS. Gauthron, M. (CEN de Saclay, Gif-sur-Yvette, France). pp 179-80 of Choice of Metallic Materials. Paris; Masson (1972). (In French).

From 13th conference on metallurgy; Saclay, France (25 Jun 1970). See CONF-700672.

The cladding of a fuel element is intended to ensure the perfect fluid-tightness between the nuclear fuel and the cooling fluid. The possibility of a burst slug occurring depends on the evolution of the properties exhibited by the cladding material: embrittlement during operation (embrittlement due to radiation or classical physicochemical embrittlement); swelling due to neutron irradiation. The stresses to which the cladding tube is subjected are due to the internal and external gas pressures and to the mechanical forces exerted by the spacers of the assembly. An example of each of these phenomena is presented for the different types of fuel element used in modern reactors. (FR)

19315 PSICO 10 EXPERIMENTAL INSTALLATION. Guerrini, B.; Lanza, S.; Mazzini, M.; Mirandola, R.; Rossi, G. (Univ., Pisa, Italy). Com. Naz. Energ. Nucl., Notiz.; 18: No. 10, 33-46 (Oct 1972). (In Italian).

A description of the PSICO 10 experimental installation built in Pisa by the University's Nuclear Plant Institute in cooperation with CNEN's Safety and Control Division and with the participation of CAMEN is presented. 11 references. (auth)

19316 NUCLEAR FUEL ELEMENT. Cayol, Andre; Vialard, Jean-Louis (to Commissariat a l'Energie Atomique). French Patent 2,100,548. 24 Mar 1972. Filed 22 May 1970. (In French).

A nuclear fuel element is described. It consists of a stack of pellets retained by a pressure part in a sealed can. This pressure part is fixed to the can with a special device. This device is in the form of a part (having a sensibly constant thickness) which

transversely blocks the can. The part, which has a diameter greater than the internal diameter of the can, is elastically compressed inside the can. The friction between this part and the can restricts its movement. (FR)

19317 FINITE ELEMENT ANALYSIS IN NUCLEAR POWER PLANTS. Mizumachi, W. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Karyoku Hatsuden: 23: No. 5, 505-14(May 1972). (In Japanese).

Since the construction of an increasing number of nuclear power plants is planned, more reliability in their design is strongly required. Therefore, it is expected that the finite element method will be widely applied to nuclear power plant design analysis. The finite element method analyzes whole systems by dividing the objects to be analyzed into finite elements which are inter-related. This method can be used to analyze any geometrically complex bodies, non-homogeneous bodies, systems whose differential equations can not be solved because of various boundary conditions, and even non-linear problems. The method can be applied to stress analysis, vibration analysis and aseismic design, and thermal problems in the design of nuclear power plants. Although it is a very useful method, it has the disadvantage of requiring large computer capacity and much calculation time. This can, however, be overcome by recent progress in computer development and the use of processing devices. (JA)

19318 UNITED STATES URANIUM POLICY. Johnson, W. E. S. Afr. Mining Eng. J.; 84: No. 4065, 25-33(Feb 1972).

It seems fairly certain that the hoped-for revival in the uranium market in the mid-1970's will not come about, but be deferred until after 1980. One of the reasons for this is that construction of nuclear reactors throughout the world has not come up to earlier expectations. The other is the new United States policy to boost its domestic uranium industry and to sell surplus government stocks over a number of years. The policy now being pursued in the United States is described in some detail. (INIS)

Reactor Physics and Core Engineering

Physics

Refer also to abstract 19264.

19319 (MATT-944) CALCULATION OF REACTIVITY WORTHS IN FISSION REACTORS. Greenspan, E. (Princeton Univ., N. J. Plasma Physics Lab.). Dec 1972. Contract AT (11-1)-3073. 42p. Dep. NTIS.

Two categories of approximations that can contribute to the reactivity worth discrepancy are considered: approximations in the theoretical formulation and its interpretation, and approximations in the actual calculations. Several pairs of expressions for the determination of reactivity corresponding to two experimental methods are given. One expression in each pair is for the experimental determination of reactivity and the other is a perturbation theory expression for the calculation of exactly the same reactivity. Errors that can be caused in the calculation of reactivity worths as a result of inconsistent reduction of the continuous energy variable to the group approximations are investigated. Fine structure effects are investigated for resolved resonances and coarse structure effects are examined for smoothly varying cross sections. Three methods for the calculation of group constants are considered: the flux method, the bilinear method, and the consistent method. It is found that the fine structure details of the importance function can have significant effects on the calculated contribution of the resonance energy range to the reactivity worth. The flux method does not account correctly for these fine structure details. It is estimated that computational techniques in common use can overpredict the reactivity worth of single resolved resonances of both fertile and fissile isotopes by more than 30%. Coarse structure considerations are expected to be important for the calculation of the reactivity contribution of processes involving a large energy transfer. For the range of problems studied the consistent method is found to be the most accurate method for reactivity calculations. (auth)

19320 (N-72-26528) NEUTRON RADIATION CHARACTERISTICS OF PLUTONIUM DIOXIDE FUEL. Taherzadeh, Mojtaba (Jet Propulsion Lab., Pasadena, Calif.). 1 Jun 1972. Contract NAS7-100. 22p. (NASA-CR-127045; JPL-TR-32-1555). NTIS.

The major sources of neutrons from plutonium dioxide nuclear fuel are considered in detail. These sources include spontaneous fission of several of the Pu isotopes, (α,n) reactions with low Z impurities in the fuel, and (α,n) reactions with ^{18}O. For spontaneous fission neutrons a value of (1.95 + or −0.07) × 1,000 n/s/g PuO2 is obtained. The neutron yield from (α,n) reactions with oxygen is calculated by integrating the reaction rate equation over all α particle energies and all center-of-mass angles. The results indicate a neutron emission rate of (1.14 + or −0.26) × 10,000 n/s/g PuO_2. The neutron yield from (α,n) reactions with low Z impurities in the fuel is presented in tabular form for one part per million of each impurity. The total neutron yield due to the combined effects of all the impurities depends upon the fractional weight concentration of each impurity. The total neutron flux emitted from a particular fuel geometry is estimated by adding the neutron yield due to the induced fission to the other neutron sources. (auth)

19321 (WCAP-8028) TWINKLE: A MULTI-DIMENSIONAL NEUTRON KINETICS COMPUTER CODE. Barry, R. F.; Risher, D. H. (Westinghouse Electric Corp., Pittsburgh, Pa.). Dec 1972. 48p.

The TWINKLE code is a neutron kinetics code which solves the multidimensional, two-group transient diffusion equations using a finite-difference technique. The code contains a detailed six-region fuel-clad-coolant transient heat transfer model at each spatial point for calculating Doppler and moderator feedback effects. The method of applying feedback corrections to the basic raw cross-sections is patterned after the design nuclear codes in use at Westinghouse. The code performs its own steady state initiatization. Up to 2000 mesh points can be used, in one-, two-, or three-dimensional rectangular geometry. The usual configuration of usage is one-dimensional axial geometry for transients with uniform radial perturbations, or three-dimensional, 1/8 or 1/2 core symmetric with one mesh per assembly and 13 axial meshes, for transients in which the radial spatial effect is important. Aside from basic cross-section data and thermal-hydraulic parameters, the code accepts an input of basic driving functions (such as inlet temperature, pressure, flow, boron concentration or control rod motion, etc.) and responds with a nuclear power vs. time. Various edits provide channelwise power, hot-channel-only power, axial offset, pointwise temperature distribution, volumetric surge and so on. The code has been used for rod ejection, anticipated transients without trip, loop stop valve opening, and other transients. (auth)

19322 MATRIX CALCULATION METHOD FOR THE CRITICAL MASS OF THE FAST REACTOR. Pavelescu, M.; Ilie, P.; Purica, I. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 8, 921-928(1972). (In Rumanian).

An extension of the method of Schmid for thermal reactors to fast reactors is presented. The transfer matrix is evaluated by a numerical technique. Critical mass calculations were made by two-group diffusion theory for a two-zone reactor by the "SAMY" code. The calculation was tested on a fast reactor of the ZPR-III 6F type. The experimental results were found in very good agreement with the theoretical calculations. The main advantage of the method described consists in having a second order critical determinant, indifferent of the number of zones. Therefore the method allows a very quick calculation. This facility becomes of importance, especially for multizone fast reactors. (auth)

19323 STUDIES IN SPECTRAL NEUTRON FLUX SYNTHESIS. Greenspan, Harold (Argonne National Lab., IL). Nucl. Sci. Eng.; 50: No. 1, 75-8(Jan 1973).

A study has been made to evaluate two aspects of the spectral synthesis method as formulated by Lorenzini and Robinson: (1) evaluation of spectral synthesis, relative to group collapsing, in terms of computational time, and accuracy for typical liquid metal fast breeder reactor problems; and (2) the numerical procedures used in solving the equations in two-dimensional geometries. Three trial spectra were used in the spectral synthesis method; the few-group calculations were done with 3, 4, and 8 groups collapsed from a 24-group set. Results were obtained and compared for k_{eff}, breeding ratios, fractional power in regions, and power distributions. (auth)

19324 MONTE CARLO CONFIDENCE LIMITS FOR ITERATED-SOURCE CALCULATIONS. MacMillan, D. B. (Knolls Atomic Power Lab., Schenectady, NY). Nucl. Sci. Eng.; 50: No. 1, 73-5(Jan 1973).

Gast and Candelore have recently pointed out that the standard method of computing confidence limits in Monte Carlo calculations is invalid for iterated-source calculations. A formula for a confidence-limit correction factor for such calculations is described. (auth)

19325 USE OF MAXIMUM PRINCIPLE IN OPTIMAL XENON SHUTDOWN PROBLEMS. Salo, Seppo (Helsinki Univ. of Tech., Otaniemi, Finland). Nucl. Sci. Eng.; 50: No. 1, 46-52(Jan 1973).

There have been some weak points in the use of modern control theory in xenon shutdown problems. The application of Pontryagin's maximum principle to these problems is presented. Two special problems have been picked up and solved completely. It is shown that the solution to the energy optimal xenon shutdown problem of Rosztoczy is not a bang-bang control as proposed by Rosztoczy even when the xenon restraint is omitted. The actual optimum control includes a phase with continuously varying control. Further, numerical examples are given to show that the difference in the costs between the optimum control and the control proposed by Rosztoczy is negligible. The other problem considered is the energy optimal xenon shutdown of Lewins et al. It is shown that the solution can be found analytically which gives a slight improvement to their analysis. (auth)

19326 ALGORITHMS OF A PRECISE MEASUREMENT OF THE REACTOR PERIOD. Kovanic, Pavel (Inst. of Information Theory and Automation, Prague). Jad. Energ.; 18: No. 8, 254-7(Aug 1972). (In Czech).

A quantitative analysis and comparison of some simple algorithms for precise measurements of stable reactor periods is given. The algorithms are suitable for a real-time computer as the necessary computer storage and its operational time are minimized. A logarithmic method based on the estimate of a ratio of two reactor power levels at two different moments has been shown to promise a good accuracy together with the practical realizability in the case of a fix-point arithmetic. (auth)

19327 DIGITAL BANDPASS FILTER METHOD: A DATA PROCESSING TECHNIQUE. Kim, Dong Hoon (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 4: No. 3, 181-5(Sep 1972).

A digital bandpass filter method is investigated for the data treatment in the measurement of the reactor transfer function. It was found that the technique is very effective in eliminating the effects of external noise. A computer code was programmed for this method. The frequency response of a digital filter is calculated, and the data treatment with this method using a digital computer was illustrated for triangular and square waveforms. Error and restriction involved in use of this method are discussed. 10 references. (auth)

19328 IMPORTANCE FUNCTIONS IN OPTIMUM THERMAL REACTORS. Kostritsa, A. A.; Nosov, B. P. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 15-19(1972). (In Russian).

Equations of importance functions were solved for reactors with minimal critical mass and with a shaped energy release. Various distributions of fuel in a reactor core were studied with a view to minimizing the critical mass. A two-group approximation with a homogeneous geometry was examined. (tr-auth).

19329 SOME REMARKS ON THE GREULING GOERTZEL APPROXIMATION FOR THE HIGHER P_L EQUATION. Yamamura, Yasunori (Okayama Coll. of Science, Japan); Sekiya, Tamotsu. J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 680-2(Nov 1972).

Core Thermal Hydraulics

19330 RADIATIVE HEAT TRANSFER BY SOLID SUSPENSION LAMINAR FLOW WITH RADIATING FLUID IN A CIRCULAR TUBE WITH CONSTANT WALL TEMPERATURE. Echigo, R.; Hasegawa, S.; Takechi, E.; Okamoto, Y. Nippon Genshiryoku Gakkaishi; 14: No. 12, 661-667(1972). (In Japanese)

In order to improve the heat transfer characteristics in gas cooled nuclear reactors, a number of devices have been proposed in the past among which the gaseous suspension of solid fine particles would appear to be the most promising, due to the good absorption of thermal radiation provided by the particulate cloud. A heat transfer analysis was performed on radiating gaseous suspension laminar flow in a circular tube with constant wall temperature, taking account of the thermal radiation to both the particulate and carrier (fluid) phases simultaneously. The results obtained for the temperature profiles and heat transfer characteristics are summarized for wide ranges of dimensionless parameters such as the radiation-conduction parameter N_R, the optical radius of multiphase medium of duct τ_{mo}, the thermal loading ratio of particles to fluid Γ and so forth. Extensive discussion is also given on comparisons of results with those of non-radiating suspension flow and of radiating gaseous flow without particulate load (single phase). (auth)

GENERAL

Civilian Defense

19331 (ORNL–4784) CIVIL DEFENSE RESEARCH PROJECT. Annual Progress Report, March 1971–March 1972. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 144p. Dep. NTIS.

Information is presented on research in 16 areas related to urban problems and civil defense. (TFD)

19332 (UCRL–51130(Vol. 10)) FINAL REPORT ON THE DEVELOPMENT OF THE GEOGRAPHICAL POSITION LOCATOR (GPL). Volume 10. Dinsii. A Navigation Data Reduction Program. Franklin, P. D.; Niven, W. A.; Cotter, N. R. (California Univ., Livermore. Lawrence Livermore Lab.). 24 Sep 1972. Contract W-7405-Eng-48. 249p. Dep. NTIS (U. S Sales Only).

Energy Economics

19333 (CONF-720963–1) ALTERNATIVE SOURCES OF ENERGY. Carlsmith, R. S. (Oak Ridge National Lab., Tenn.). [nd]. 9p. Dep. NTIS.

From 26th annual conference of the Middle East Institute, Washington, D. C. (29 Sep 1972).

Important alternatives that have been proposed for energy production are gas and oil from coal, oil from tar sands and from oil shale, nuclear fission, nuclear fusion, solar energy, industrial wastes, and geothermal energy. Gas and oil supply 78% of the energy used in the United States and 61% for the entire world. Transportation in the US is dependent on petroleum fuels. The utilization of coal involves new processes that produce low-Btu gas and synthetic crude oil from coal. Economical and environmental impacts are discussed for both fossil- and nuclear-fuel processes. (JCW)

19334 (CONF-721131-1) ENERGY AND WATER: PRECURSORS TO DEVELOPMENT. Michel, J. W. (Oak Ridge National Lab., Tenn). 1972. 14p. Dep. NTIS.

The developments of the past 15 years have brought about significant changes in the science of desalting the sea, and the momentum of advance is such that further improvements are certain to occur. The most important step, however, will be the transition to large-scale equipment. The technology is adequate for this step, which will in itself bring about reductions in cost. But the rate of such transition will be governed by the policies of governments—by commitments to develop new land that relies on desalted water sources, by water pricing policies, and by subsidy of the initial steps in the scale-up of units. (auth)

19335 HYDROGEN ECONOMY. Gregory, D. P. Sci. Amer.; 228: No. 1, 13-21(Jan 1973).

A case is made for an energy regime in which all energy sources would be used to produce hydrogen, which could then be distributed as a nonpolluting multipurpose fuel. (auth)

19336 PATTERN OF PRIMARY ENERGY SOURCES FOR THE GENERATION OF ELECTRICITY IN THE 70s AND 80s. Mandel, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). J. Brit. Nucl. Energy Soc.; 12: No. 1, 11-19(Jan 1973).

The development of the consumption of primary energy and the breakdown into primary energy sources is shown for the EEC, Federal Republic of Germany, UK, and USA. The possible evolution of primary energy consumption to 2000 AD, and the estimated share of nuclear energy is predicted. Low installation cost will be the essential criterion for the economic success of the nuclear plant. An estimate is given of the generating costs for different reactor types and unit sizes. It is considered that light-water reactors could account for approximately 80% of nuclear power by 1980, the fast breeder gaining an increasing share of the market by the second half of the 80's. Only at unit sizes of 2000 MW(e) might fast reactors become competitive. The advantages of high-temperature reactors and their development potential in combination with the closed-cycle gas turbine are discussed. Finally, stress is laid on the importance to the nuclear industry of international cooperation especially in the fuel fabrication, reprocessing, and enrichment industries. The final aim should be the creation of multinational companies. (UK)

Information Handling

19337 (ORNL-TM-3997) SURVEY OF THE BIOLOGICAL-SCIENCE-RELATED INFORMATION CENTERS LISTED IN THE SEQUIP REPORT. Cottrell, W. B. (Oak Ridge National Lab., Tenn). Jan 1973. Contract W-7405-eng-26. 19p. (CONF-720965-1). Dep. NTIS.

A summary was presented at the National Environmental Information Symposium of the information centers concerned with the biological sciences. The SEQUIP Report provides a general description of these centers. One survey identified the information provided by the center, who was served, and from what resources. The second survey consisted of an individualized inquiry sent to each center in order to evaluate its response. The results of both surveys are evaluated and many significant conclusions drawn; most poignant among them are: 1) a satisfactory response was obtained from only about half of the "centers" contacted, and 2) personal contact will elicit the best response. (auth)

19338 EXPANDED ROLE FOR RESEARCH AUTHORS IN SCIENTIFIC INFORMATION HANDLING. Farhataziz; Watson, E. Jr. (Univ. of Notre Dame, IN). Nucleus (Karachi); 9: No. 1-2, 5-8 (1972).

The scientific world is faced with the problem of handling a large scientific information production. The tools are there. However, the input to these tools is basically manual. It seems proper that the scientific author should accept the responsibility to be the primary agent for expediting the manual portion of the job. Furthermore, journals should take up the problem seriously and within a reasonable span of time must change the style of publication by including a codified analysis of the paper and data summaries. This is an urgent demand of today's computer-oriented scientific information operations. (auth)

Law

Refer also to abstracts 17603, 17604, and 17946.

19339 REGULATORY CONTROL OF IONIZING RADIATION IN CANADA. Dasgupta, A. K. (Dept. of National Health and Welfare, Ottawa). Amer. Ind. Hyg. Ass. J.; 33: No. 6, 412–418(Jun 1972).

In Canada, the procurement, use, disposal, and other activities involving radioactive materials are governed by the Atomic Energy Control Act. In 1970, the Radiation-Emitting Devices Act brought most other potentially harmful radiation sources under surveillance and control. The development and growth of the monitoring and control programs of the Radiation Protection Division of the Department of National Health and Welfare are described for the period 1950 through 1970. (auth)

19340 COOPERATIVE REGULATORY PROGRAM FOR CONTROL OF RADIATION. Kerr, G. W. (Atomic Energy Commission, Washington, DC). Amer. Ind. Hyg. Ass. J.; 33: No. 6, 406–411(Jun 1972).

A program providing for the transfer from the U. S. Atomic Energy Commission to the states certain regulatory control over by-product, source, and small quantities of special nuclear material was made possible by the enactment of Section 274 of the Atomic Energy Act of 1954. Kentucky became the first state to assume this authority on March 26, 1962, and since that time a total of twenty-three states have entered into the Agreement State program. The key to the effectiveness of this program is the extensive cooperative efforts that are put forth by each of the state regulatory agencies and by the AEC. The experience gained over this nine-year period illustrates that the program has been effective and might serve as a model for other federal-state-local cooperative programs. (auth)

19341 PUBLIC HEALTH RESPONSES OF LOCAL GOVERNMENTS TO ATOMIC ENERGY FACILITIES WITH SPECIAL EMPHASIS ON ENVIRONMENTAL MONITORING. Yamagata, N. (Inst. of Public Health, Tokyo); Iwashima, K.; Koike, R.; Ozu, S.; Kitagawa, S. Koshu Eiseiin Kenkyu Hokoku; 20: No. 4, 212-26 (Dec 1971). (In Japanese).

The present effort of local governments to cope with nuclear facilities, especially power plants, was reviewed in order to check the appropriateness of the existing national legal system for radiation control and make available to local governments that are going to have such facilities the knowledge required.

One of the barriers that hinder the local governments in making rational and legislative responses to nuclear facilities in the field of radiation protection and safeguards is that the environmental protection with respect to all kind of materials is legally based on the Pollution Control Act with the only exception being radioactivity, which is controlled on the basis of the Atomic Energy Act. The latter Act is solely within the competence of the central government under the auspices of the Atomic Energy Bureau, Science and Technology Agency, the principal duty of which is the development of atomic energy. (auth)

Management

Refer also to abstract 17508.

19342 INDUSTRIAL ENVIRONMENTAL HEALTH. THE WORKER AND THE COMMUNITY. Cralley, L. V. (ed.). Environmental Sciences, An Interdisciplinary Monograph Series. New York; Academic Press Inc. (1972). 562p. $24.00.

Separate abstracts were prepared for two chapters. One discusses radiation protection standards for uranium miners in the USA and the second discusses radiation protection programs for industries using ionizing radiations. Thirteen additional chapters discuss various occupational hazards and their control. (CH)

For abstracts of individual chapters see: 17687 and 19343.

19343 IONIZING RADIATION. Schulte, H. F. (Los Alamos Scientific Lab., NM). pp 243-69 of Industrial Environmental Health. The Worker and the Community. /Cralley, L. V. (ed.). New York; Academic Press Inc. (1972).

The use of radiations and radioactive materials by industry is increasing and possible health hazards to industrial personnel are discussed. It is pointed out that even in installations where high levels of radiation can be encountered the occupational physician finds that almost all of his work deals with nonradiation problems unless he also directs the radiation protection programs. In such installations training and preparation for the possibility of serious radiation accidents are required, even though they are never used. Methods used for estimating external radiation exposure doses and internal radiation doses following the uptake of radioisotopes are reviewed. Monitoring methods and the efficiency of various types of radiation detectors used for dosimetry and monitoring are discussed. The hazards of release of radioactive wastes to the environment are considered briefly. The various agencies in the USA that are concerned with the development of radiation protection guides, regulations, and standards are listed. (CH)

19344 HEALTH PHYSICS TRAINING AT THE NATIONAL CENTER FOR SCIENTIFIC RESEARCH. Bonet-Maury, P. (Centre National de la Recherche Scientifique, Paris); Choquet, R.; Levy, C. pp 1029-38 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972). (In French).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

Sources of ionizing radiation are used in many of the CNRS and university laboratories. The largest of these sources require the presence of health physics specialists. With sources presenting smaller risks (e.g., low power x-ray generators and radiotracers), only specially authorized personnel having the appropriate training are allowed to handle the equipment. Experience demonstrates that most scientists and technicians are either unaware or wrongly informed about the risks associated with ionizing radiations. The Preparatory Training in the Techniques of Research courses run by the CNRS over the past seven years meet the required needs. These courses enable a general knowledge of health physics (physics, techniques, biology, medico-legal aspects) to be acquired during a 5 full day course involving a series of conferences and practical work. (auth)

19345 RADIATION PROTECTION IN A UNIVERSITY ENVIRONMENT. PRACTICES AND DEVELOPMENTS IN THE UNITED KINGDOM. Hewitt, P. J. (Univ. of Bradford, Eng.). pp 1039-48 of New Trends in Radiation Protection. Montrouge, France; Societe Francaise de Radioprotection (1972).

From 6th international congress on new trends in radiation protection; Bordeaux, France (27 Mar 1972). See CONF-720328.

In the U.K. most Universities have established a radiation protection service, which acts in an advisory capacity to the University authorities. This involves direct access to the highest level within the University, together with establishment of good relationships through departmental radiation supervisors. Statutory requirements relating to radionuclide usage, and especially waste control, must be observed. These strict legal requirements are supplemented by Codes of recommended Practice, which allow a measure of flexibility suited to a research environment. Reappraisal of the functions of University radiation protection services in U.K. can be expected to lead to the following developments: the widening of responsibilities to include all aspects of radiation, not only that which causes ionization; extension of the expertise developed in environmental monitoring and containment into comprehensive industrial hygiene services; development of central service laboratories providing initially radionuclide supplies and training in their usage, and ultimately analytical services such as those based on neutron activation or x-ray fluorescence; a wider education role, not only to students in the safe use of radioactive materials, but in the context of risk benefit analysis and the broader aspects of environmental hazards. (France)

Mathematics and Computers

19346 (EIR-211) FLETCH: OPTIMIZATION CODE OF LINEAR SYSTEMS WITH A QUADRATIC FUNCTION OF COST. Raboud, P. B.; Thomi, P. A. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jul 1972. 87p. (In French). Dep. NTIS (U. S. Sales Only).

19347 (EUR-4928) ON THE SOLUTION OF PLANE STRESS PROBLEMS BY FINITE-ELEMENTS COMPUTER PROGRAMS. Gaggero, G.; Candolfo, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb 1973. 30p. Dep. NTIS(U.S. Sales Only). EURB.FR. 60,-.

The goal of the present study is to obtain information which facilitates the treating of practical problems with satisfactory results and low computer cost. A comparison of different computer programs, when applied to a series of discrete models of a cantilever beam, is given. Calculated results are also used to study the influence of the mesh orientation and refinement on the convergence of the discrete model to the actual situation. The finite element used in the discretization is the simple plane-stress triangle. Different types of elements (triangle with midside modes, quadrilateral and quadrilateral with midside nodes) are investigated, and the obtained displacements and stresses are compared. Finally, some considerations on the required computer time are presented. (auth)

19348 (UCID-30052) CIE MEETING NUMBER 122: APL* LANGUAGE SPECIFICATION AND COMPILER PROGRESS. Zwakenberg, R. G. (California Univ., Livermore. Lawrence Livermore Lab.). 22 Aug 1972. Contract W-7405-eng-48. 29p. Dep. NTIS.

Miscellaneous

19349 (AEC-tr-7399) ANNOUNCEMENT ON THE ESTABLISHMENT OF A NUCLEAR ENGINEERING COMMITTEE. Translated from German. 1 Sep 1972. 5p. Dep. NTIS.

19350 (BARC-611) SPECTROPHOTOMETRIC TITRATION OF VANADIUM(V) WITH IRON(II). Parab, S. V.; Murthy, T. K. S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 12p. Dep. NTIS (U.S. Sales Only).

19351 (BARC-620) INPUT SPECIFICATIONS AND THEIR IMPORTANCE IN ELECTROMYOGRAPHY. Menon, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 36p. Dep. NTIS (U. S. Sales Only).

19352 (BARC-631) THERMAL DECOMPOSITION OF RARE EARTH OXALATES IN VACUUM. Sampath, S.; Chackraburtty, D. M. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 19p. Dep. NTIS (U.S. Sales Only).

19353 (BDX-613-793(Rev.)) CLEANING AND ASSEMBLY TECHNIQUES, FY73-1. Quarterly report. Waddell, M. L. (Bendix Corp., Kansas City, Mo.). Nov 1972. Contract AT (29-1)-613. 21p. Dep. NTIS.

19354 (BDX-613-804) NUMERICALLY CONTROLLED ASSEMBLY. Final report. Hughes, R. W. (Bendix Corp., Kansas City, Mo.). Dec 1972. Contract AT(29-1)-613. 47p. Dep. NTIS.

19355 (BNL-17519) MAGNETIC STRUCTURE OF $RbMnBr_3$. Glinka, C. J.; Minkiewicz, V. J. (Maryland Univ., College Park); Cox, D. E. (Brookhaven National Lab., Upton, N. Y.); Khattak, C. P. (State Univ. of New York, Stony Brook, Brookhaven National Lab., Upton, N. Y.). 1972. 5p. (CONF-721114-17). Dep. NTIS.

From 18th annual conference on magnetism and magnetic materials; Denver, CO (28 Nov 1972).

19356 (BNL-17520) MAGNETIC ORDERING OF THE LINEAR CHAIN ANTIFERROMAGNET $CsMnBr_3$. Eibschuetz, M.; Sherwood, R. C.; Hsu, F. S. L. (Bell Telephone Labs., Inc., Murray Hill, N. J.); Cox, D. E. (Brookhaven National Lab., Upton, N. Y.). 1972. 6p. (CONF-721114-16). Dep. NTIS.
From 18th annual conference on magnetism and magnetic material; Denver, CO (28 Nov 1972).

19357 (BNWL-SA-4087) ARID LAND ECOLOGY RESERVE. An Outdoor Laboratory. Price, K. R. (Battelle Pacific Northwest Labs., Richland, Wash.). 1971. 5p. Dep. NTIS.

19358 (BNWL-SA-4095) CONCENTRATION FLUCTUATION AND PEAK-TO-MEAN CONCENTRATION RATIOS IN REAL PLUMES. Ramsdell, J. V. (Battelle Pacific Northwest Labs., Richland, Wash). Dec 1971. Contract AT(45-1)-1830. 20p. (CONF-711210-4). Dep. NTIS.
From Air Pollution, Turbulence and Diffusion Symposium; Las Cruces, New Mexico, United States of America (USA) (7 Dec 1971).
Time-integrated plume diffusion models are inadequate to solve current air pollution problems in some instances and fail when instantaneous concentration predictions are needed. Theoretical viewpoints have been shown, and in 1967, a series of diffusion tests were conducted at Hanford to study concentration fluctuations associated with real plumes. A description of the magnitude of the fluctuations and the systematic way they vary are given. (JCW)

19359 (CALT-822-31) ELECTRICAL RESISTIVITY AND MAGNETIC SUSCEPTIBILITIES OF AMORPHOUS Cr-Ni-Pt-P ALLOYS. Sinha, A. K. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.). Jun 1971. Contract AT(04-3)-822. 8p. Dep. NTIS.

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